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JACKSONIAN PRIZE.

THE Council of the Royal Australasian College of Surgeons has been advised by the Council of the Royal College of Surgeons of England that the subject chosen for the Jacksonian Prize for the year 1945 is as follows: "Bone Grafting in Surgery: Its Indications, Methods and Results." Full details governing the conditions of the prize may be obtained from the Secretary of the Royal Australasian College of Surgeons, Spring Street, Melbourne, C.1.

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THE GEORGE ADLINGTON SYME ORATION.

RECENT INVESTIGATIONS CONCERNING THE BIOCHEMISTRY OF THE THYREOID GLAND.[1]

By VICTOR M. TRIKOJUS,
Professor of Biochemistry, University of Melbourne.

IT would be presumptuous on my part to endeavour to find words in eulogy of him whose name is permanently associated with the oration that I have been called upon to deliver. Those of his colleagues who knew him intimately have, on the appropriate occasions, offered written testimony to the esteem in which he was held professionally and to his outstanding qualities as a man, whilst within my own generation none could fail, in the reading, to receive inspiration to carry further forward the torch of achievement. I do not propose to say more then, in introduction, than how deeply sensitive I am of the honour inseparable from the invitation to address the College on this evening of commemoration.

Acting on the suggestion of your Council, I have chosen to speak on the biochemistry of the thyreoid gland, not only because it is a subject in which I have been interested for some years, but also since the comparatively recent advances that have been made in our knowledge concerning the mechanisms underlying the functions of this gland have led to important applications in medical practice. Biologist, clinician, microanalyst, chemist and, latterly, the atomic physicist have all become attracted by the mysteries of iodine metabolism, and it is probable that only through such combinations of specialized interests will the ætiologies of thyreoid dysfunction become clarified.

Of prime consideration in thyreoid research have been the questions as to the nature of the intrafollicular colloid of the gland, the mechanisms involved in its normal synthesis and degradation, and the precise conditions which determine its qualitative and quantitative fluctuations in the pathological state.

Next year will mark the semi-centenary of the discovery by Baumann[(1)] that the element iodine formed a vital part of the colloid protein (thyreoglobulin), but it is less than twenty years since the classical researches of Harington and co-workers enabled the identification of the iodine-containing fragments as the two amino acids diiodotyrosine and thyroxine, the latter a substance of extremely marked calorigenic activity; its potency is exceeded,

[1] Delivered at the annual meeting of the Royal Australasian College of Surgeons on May 26, 1944. Accepted for publication on September 11, 1944.

as Loeser and I[2] have shown, only by that of its methyl derivative. The early suggestion of Harington and Barger,[3] that the synthesis of thyroxine occurred *in vivo* through the combination of two molecules of diiodotyrosine, has been supported by the results of investigations over the past four years, to which reference will be made later.

During recent years purified thyreoglobulin from normal, hyperactive and hypoactive human thyreoids has been subjected to detailed studies by Cavett and co-workers,[4][5] from which several interesting conclusions have been drawn. Thyreoglobulins from all types of human thyreoid gland were found to be essentially the same protein, excepting that the percentage of iodine, bound as diiodotyrosine and thyroxine, was appreciably lower in the goitrous glands than in the normal. Since the thyreoids from cases of colloid, adenomatous and exophthalmic goitre all showed a reduction in the content of these iodo amino acids, it was concluded that the cause of the marked clinical differences in the goitre types should be sought elsewhere than in the thyreoglobulin. It might be observed in this connexion that in exophthalmic goitre a higher intake of iodine is necessary to bring about a positive iodine balance than in the normal subject.[6] Thus we have, in this clinical condition, the anomaly of a greatly increased demand for iodine by the thyreoid gland being accompanied by an abnormally high level of excretion from the body. A similar negative balance on a low iodine intake has been found in toxic but not in non-toxic nodular goitre. It is true that the thyreoid of Graves's disease shows a qualitative and quantitative improvement under the influence of excess iodine, but the percentage of thyroxine iodine to total iodine in the gland appears to remain at subnormal levels.

Little is known about the exact nature of the organically bound iodine in circulation, and this is one field of thyreoid research in which the development of more elegant experimental techniques should yield results of importance. There is indirect evidence[7] that both the blood and the tissues contain substances which can increase the oxygen consumption of tissue and accelerate metamorphosis,[8] but there is no proof that these are present as thyreoglobulin. In fact, using a highly potent antiserum to human thyreoglobulin, Lerman[9] was unable to detect this protein either in normal or thyreotoxic human serum. Whatever may be the nature of the complex iodine-containing compounds in the blood, these would appear to be located in the plasma protein, so that the determination of the iodine content of this fraction affords some indication of the functional state of the thyreoid gland, and is better suited for this purpose than is the estimation of the total blood iodine.[10] In hyperthyreoidism the value is raised; the opposite is the case in myxœdema. Of greater interest is the fact that under iodine therapy the plasma protein iodine has been found to attain a higher level in the normal subject and in the presence of toxic nodular goitre, post-operative hypothyreoidism and myxœdema, whereas a fall is characteristic of typical Graves's disease. A satisfactory explanation of these partly anomalous results must await a more exact determination of the chemical nature of the components of the organically bound iodine complex in circulation.

A new technique in the study of iodine metabolism has been recently afforded through the discovery of radio-active isotopes of this element. By the bombardment of atomic nuclei with rapidly moving particles such as protons, neutrons, helium nuclei or deuterons (heavy hydrogen nuclei)—the velocities of which have been enhanced by passage through a cyclotron—it has been found possible to produce a great number of radio-active isotopes of the common elements, several of which have been used with conspicuous success in the clarification of certain obscure points in intermediate metabolism.

The great advantage in this technique lies in the fact that, whereas in ordinary chemical, physical and biological processes the radio-active isotopes behave exactly as the stable forms of the corresponding elements, they become modified and can be detected in extreme dilution by comparatively simple physical apparatus at the moment they begin to disintegrate—that is, manifest their radio-activity.

Several radio-active iodine isotopes have now been produced by the bombardment, for example, of the metal tellurium with deuterons. Those isotopes of atomic weights 131 and 128 (compared with 127 for normal stable iodine) have proved the most useful in clinical and animal experiments.[131-133] In such investigations a minute quantity of the radio-active isotope is administered, after admixture with ordinary iodine—usually as iodide—so that the latter becomes "labelled" or "tagged" during its passage through the organism. Iodine^{131}, having a half-life period of eight days, is more suited to physiological investigations than I^{128} with the short period of twenty-five minutes, although the latter in concentrated form has been reported as offering distinct possibilities in the treatment of tumours and hyperplasia of the thyreoid. The short life of this isotope, considered in conjunction with the avidity of thyreoid tissue for iodine, enables an intense and close range bombardment to be achieved with the minimum of damage to other tissues. Such selective localization of the radiation offers obvious advantages over the more usual X-ray therapy.

In metabolic studies on iodine the radio-active isotope of long period, I^{131}, has provided a means of determining *in situ* the functional activity of the thyreoid gland in respect of this element in the human and in the laboratory animal, under normal and pathological conditions. In such investigations the "iodine-hunger" of the hyperplastic gland, compared with that in the normal subject, becomes apparent. Iodine uptake in toxic goitre was found to be maximal within the first few hours, and it then fell sharply to more normal levels, whereas a smooth curve, reaching a maximum after about forty-eight hours, characterized the normal gland and that of non-toxic goitre. In the atrophic gland of myxœdema, radio-active iodine could barely be detected.

From what has been already stated a reasonable assumption would be that, whatever the ætiologies of the several types of thyreoid dysfunction, these abnormal conditions become revealed basically as problems of iodine metabolism at different levels. However, an exact interpretation of some of the observations as, for example, the reduction which occurs in the plasma protein iodine in Graves's disease during treatment with iodine, with the very marked opposite effect in the case of myxœdema, is still awaited.

In turning from the consideration of iodine and thyreoid function, our attention should next be focused on the thyreotrophic hormone of the anterior pituitary.[119] An integration of the results of the very extensive series of investigations that followed the recognition of this separate pituitary principle in 1929, lays emphasis on the close connexion between the thyreoid and pituitary glands and, in particular, on the delicate nature of the thyreoid-pituitary-iodine equilibrium. Ablation of the hypophysis brings about a resting state in the thyreoid gland, with lowered basal metabolic rate associated with a decrease in the rate of synthesis and excretion of thyroxine, whilst the continued administration of the thyreotrophic hormone leads experimentally to an almost exact replica of Graves's disease. It has also been found possible to raise still further the basal metabolic rate in human exophthalmic goitre by the injection of purified preparations of the hormone.[115-116] It might thus appear satisfying to regard an excess production

of the thyreotrophic hormone by the hypophysis as a prime factor in the ætiology of clinical hyperthyreoidism. In favour of this thesis the evidence so far accumulated is indirect and inconclusive, and even if it were correct we would still need to seek elsewhere the responsibility for the precipitation of the state of pituitary hyperactivity.

An increased output of the thyreotrophic hormone has been found to accompany a lowering of the environmental temperature,[17] and also certain phases of normal growth,[18] associated in both cases with an elevation in the rate of production of thyreoid hormone. On the other hand, any process which seeks to depress the synthesis of the thyreoid hormone, such as medication with drugs of the thiourea type, will likewise induce compensatory hyperfunction on the part of the pituitary body.[38-42] A further significant demonstration has been that of Mills,[19] who showed the presence of appreciable quantities of thyreotrophic hormone in the blood of cats after electrical excitation of the hypothalamus.

The search for thyreotrophic activity in the body fluids of Graves's disease has, however, yielded only negative results to the majority of investigators. Even at two- and four-hour intervals subsequent to the intramuscular administration of a single large dose of thyreotrophic hormone, my colleague, Dr. A. R. Robinson,[10] still obtained negative responses from concentrates of as much as 100 cubic centimetres of the blood of patients with Graves's disease. Whilst Hertz and Oastler[20] have provided convincing evidence of thyreotrophic activity in the serum and urine of post-operative myxœdema, other investigators[21] have found the corresponding fluids in spontaneous myxœdema, and in the normal subject, to be inactive. It must be remembered that the methods used for detection of the hormone are those of bioassay, and as such would fail to discriminate between the state of complete absence of a thyreoid stimulating factor and that in which an equal or greater quantity of anti-thyreoid or anti-thyreotrophic substance was present as contaminant. Certain specimens of thyreotoxic serum and urine have been shown, in fact, to have a depressant effect on the thyreoid of the laboratory animal, but the question as to whether this property is associated with the thyreoid hormone-like fraction of the blood, or with other factors "anti-hormone" in nature, can only be answered subsequent to more detailed investigation.

It would seem appropriate here to examine further the known interactions of the thyreoid and pituitary glands and iodine from the aspect of a normalization or reduction of thyreoidal activity, since this is more the concern of the clinician than is the production of a state of hyperfunction. The direct effect of iodine on the storage of hormone by the thyreoid has been clearly established, but its action would appear to be conditioned, at least partly, by the presence of the pituitary. Thus the continued administration of small doses of iodine to the rat has been shown to diminish the content of the pituitary in thyreotrophic hormone.[22] In an attempt to present experimentally the syndrome of human hyperthyreoidism before and after pre-operative iodine therapy, we injected two groups of guinea-pigs with progressively increasing doses of thyreotrophic hormone, and to one of these groups clinically comparable doses of iodine, as potassium iodide, were given concurrently.[23-24] Even under these extreme conditions of thyreoid stimulation the favourable influence of iodine on colloid storage was evident as judged symptomatically and from the greatly modified histological appearance of the thyreoids of the iodized animals. In fact, within certain limits, it has been our general experience that the greater the activity of the thyreoid gland, the more effective is the administration of iodine upon colloid storage.

The influence of thyroxine and its calorigenically potent derivatives in favour of colloid storage by the thyreoid gland is even more marked than with iodine, and it is presumed here that the initial effect is one of reduced pituitary output. Thus an appreciably larger dose of thyreotrophic hormone is needed to stimulate the thyreoid gland of an animal treated with thyroxine.[23,24] Pertinent to the present discussion are the recent investigations of Reforzo-Membrives.[25] In what would appear to have been carefully controlled experiments, the pituitary glands of rats, in receipt of thyreoid substance for three to four weeks, were injected into normal guinea-pigs and found to decrease the basal metabolic rate and also to diminish the size and rate of respiration of the sensitive thyreoid of this animal. On the other hand, the test animals reacted in the opposite direction—that is, with an increased basal metabolic rate, increased size and rate of thyreoid respiration—when injected with the pituitaries from the control group of rats not treated with thyroxine. The novel observation in these experiments is not the depression of thyreotrophic activity in the pituitary by thyroxine, but that this gland has been stimulated to act in reverse to secrete a substance with the function of either an anti-thyreoid or anti-thyreotrophic hormone. These results, if confirmed, will raise again the question of the significance of the theory of anti-hormones as postulated by Collip.[26-28] In view of the close connexion that exists between the endocrine and nervous systems, it would perhaps not be surprising to find a general principle of reciprocal hormonal control acting as a counterpart to that of reciprocal innervation.

Relevant to the question of intrapituitary antagonisms are possibly our present studies on the action *in vitro* of iodine upon highly purified thyreotrophic hormone.[29] Our observations so far indicate that by introducing small quantities of iodine into the hormone, under mild conditions, some activity is still preserved, whereas by increasing the percentage of combined iodine the iodized hormone now functions as anti-thyreotrophic. However, although the pituitary, like the ovaries and adrenals, contains under normal conditions an appreciable concentration of iodine, the latter's exact hypophyseal function is unknown, so that our results at present can provide no more than weak presumptive evidence for the existence of another role on the part of this intriguing element (see Table I).

TABLE I.

The Iodination of Thyreotrophic Hormone (in vitro).

Experiment Number.	Percentage of Reacting Iodine to Hormone on Basis of Weight.	Resulting Iodo Protein.
A	40·0	Antithyreotrophic.
B	20·0	Antithyreotrophic.
C	8·0	Thyreotrophic (weak).
D	4·0	Thyreotrophic (moderate).
E	0·8	Thyreotrophic (moderate).
—	0·0	Thyreotrophic (marked—34 units per milligramme).

The readiness with which iodine can enter into chemical combination with various proteins can be easily demonstrated. In fact, the hypothesis that thyreoidal activity could be thus induced was first tested by Baumann

towards the close of last century, but with negative results. More recently, however, improved techniques have led to the isolation of several artificial iodinated proteins, for example, those derived from serum albumin and milk casein, which have proved as effective as desiccated thyreoid in the alleviation of the symptoms of myxœdema.[30]

The isolation of pure crystalline thyroxine from the hydrolysate of iodo casein by Ludwig and von Mutzenbecher[31-33] in 1939 has indicated the basis of the calorigenic activity of such compounds. Furthermore, the conversion of diiodotyrosine into thyroxine, with the simultaneous elimination of pyruvic acid and ammonia, has been successfully accomplished *in vitro*,[34] although in small yield (see Table II). In view of these results the question immediately arises as to whether thyroxine can be formed in the body elsewhere than in the thyreoid gland. An answer to this query has been recently provided by Chaikoff and collaborators,[35] at least for the laboratory animal. In carefully conducted experiments, when radio-isotopic iodine was used, the completely thyreoidectomized rat and also the thyreoidectomized-hypophysectomized animal were shown capable of converting a significant proportion of the administered iodine into diiodotyrosine and thyroxine. It is clear, however, that if the extra-thyreoidal synthesis of thyroxine is found to take place under normal physiological conditions in man, the contribution from these sources is probably of minor consequence, or else it must be assumed that in the myxœdematous condition both synthetic mechanisms are suppressed, since this disease does not respond to iodine alone.

On the other hand, in the light of our knowledge of the mechanism of thyroxine formation *in vivo* we might ask whether the body could be provided with the means to depress the high rate of conversion of diiodotyrosine into thyroxine, as is presumed to occur in toxic goitre. One method of approach would be to discover the enzymic nature of the chemical reactions involved, and then to produce an enzyme-inhibitor of low toxicity to the host. In the recently introduced enzyme inhibitory treatment for Graves's disease,[46-49] entailing the administration of thiouracil or equivalent drug, the inhibitor was actually discovered before the enzyme—a not unusual reversal of procedure in chemotherapy. According to the current literature, the vital enzyme is thyreoid peroxidase, the presence of which can be demonstrated, as claimed by Dempsey,[36] in frozen sections of the human gland (see Table II).

TABLE II.

TYROSINE (two molecules)

↓ + Iodine

DIIODOTYROSINE (two molecules)

↓ + O (? Peroxidase; chemical oxidation)

THYROXINE (one molecule) + Ammonia + Pyruvic Acid

Considered, however, in correct order, the rationale for the newer therapy really depended upon the results from three lines of investigation. The occurrence of thyreoid hyperplasia with lowered metabolic rate in rabbits fed on a cabbage diet had been shown many years ago,[37] whilst more recently Purves, Kennedy and co-workers[38-41] in New Zealand, in extending their work on the nature of the goitrogenic agents in seeds of the Brassicæ family, observed marked hyperplasia and hypertrophy in the thyreoid and changes in the cellular pattern of the pituitary of the rat after the oral administration of small doses of allyl-thiourea. Just prior to this report the anti-dysentery

drug sulphaguanidine had been shown to act similarly when incorporated into the diet of the same animal,[42] even in the presence of *p*-amino benzoic acid, a substance known to antagonize the bacteriostatic action of the sulphonamide drugs. Thirdly, the introduction of the thiocyanates into the treatment of hypertension had led, in certain instances, to a lowered metabolic rate and the clinical signs of myxœdema.[43][44]

Microscopically the thyreoid glands resulting from the three forms of treatment just outlined resemble very closely the corresponding tissue in human thyreotoxicosis, but the associated symptoms are those of hypothyreoidism. However, the hyperplasia and hypertrophy of the thyreoid have been shown to result from an indirect action of the drugs, since they are absent in the hypophysectomized animal. In the intact animal, under the influence of these drugs, the pituitary is stimulated towards increased production of the thyreotrophic hormone in a vain endeavour to compensate for the depressed synthesis of thyreoid hormone. Furthermore, whilst the drugs can prevent the symptoms of hyperthyreoidism normally resulting from injections of the thyreotrophic hormone, they fail to inhibit the hyperplasia of the thyreoid gland under this stimulus. Thyroxine or desiccated thyreoid administered concurrently does appear to neutralize the effects of the drugs, but the colloid of the now apparently normal gland is found to be deficient in its active principle. Therefore, it must be concluded that thyroxine and the goitrogenic agents exert their direct effects independently, the former raising the metabolic rate and depressing pituitary activity, the latter inhibiting synthesis in the thyreoid gland.

In an investigation previous to clinical trials Astwood[45] examined the activity and toxicity of over 100 chemicals related in structure to thiourea, sulphaguanidine and thiocyanate. In the reports so far available, chemotherapy in human thyreotoxicosis has been restricted to the use of thiourea and thiouracil, but further work will doubtless make available, as with the sulphonamide group of drugs, substances of improved quality. It would be beyond the scope of this address, and I should, moreover, find myself trespassing in another's field, if I attempted to recapitulate the clinical findings in this newer treatment of exophthalmic goitre. The cases have been admirably presented by Ritchie and Geddes,[46] Bissell and Williams,[47] Himsworth[48] and in the original paper by Astwood.[49]

May I, however, be permitted to point out that in the animal experiments with these drugs the thyreoid gland is initially at the level of normal function, whereas if applied immediately in human thyreotoxicosis the effect would usually be on tissue already hyperplastic. It would seem preferable to attempt to restore the patient first of all to endocrine and sympathetic balance by the regular pre-operative iodine therapy and to continue treatment with thiourea or equivalent drug *plus* iodine or perhaps small doses of desiccated thyreoid, since the latter would exert a more pronounced influence in inhibiting the production of thyreotrophic hormone by the pituitary, thereby reducing the degree of concomitant hyperplasia. It is true that iodine has been stated to be ineffective in preventing the goitrogenic action of thiourea, but more experimental work of a quantitative nature would seem to be indicated, particularly as both iodine and diiodotyrosine were found by Purves[51] to moderate the degree of thyreoid hyperplasia induced by the goitrogenic agent in Brassicæ seeds.[*cf.* 50] Dramatic as have been the clinical results of thiourea therapy, we are still far from the ideal, since the fact remains that in this treatment the emphasis in human thyreotoxicosis is still on the thyreoid gland, which is most likely the victim and not the cause of the disease.

In my final remarks I should like to draw attention to the recent report[32] from the Cambridge school concerning the properties of the substance paraxanthine which has been isolated from human urine, ox blood and liver, and which is probably of wider occurrence. Briefly stated, a small dose of this compound injected into a normal rat was found to depress the basal metabolic rate, whereas if the dose was now carefully increased there was a prompt return to the normal level. In association with this higher dosage a carefully graded injection of thyroxine produced the astonishing result of a fall in the basal metabolic rate to the lower level. A corresponding neutralization of excess thyroxine could be achieved by an injection of an appropriate dose of paraxanthine. The implications of these results as to the role of paraxanthine in the normal animal in controlling the action of thyroxine are strong indeed, but the authors, pending further research, have wisely avoided speculation. But even with the discovery of a direct antagonist to thyroxine would the problem reach the final stages of its solution? The extensive ramifications of the thyreoid hormone in metabolism would lead us to presume the existence of a number of primary and secondary regulators of its action. Some of these factors have been considered this evening, but the spirit of inquiry, strengthened by organized teamwork, has still to be as concerned with the discovery of new principles as with the correlation and extension of known data. Towards the furtherance of these objectives it is indeed pleasant to be able to record the stimulus provided by the enviable reputation in thyreoid treatment which this city has enjoyed over so many years.

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THE REMOVAL OF BLOOD FROM TRAUMATIC HÆMOTHORACES.[1]

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CHEST injuries in a large proportion of cases result in bleeding into one or both pleural cavities. This hæmorrhage nearly always ceases spontaneously in patients who survive to reach a medical post. The removal of the extravasated blood after the hæmorrhage has ceased is therefore usually the main problem in the treatment of patients with traumatic hæmothorax. This article is concerned with this problem in all its aspects, and special reference will be made to its solution in areas like New Guinea where difficulties are created by a long, hazardous journey to hospital and by lack of special equipment.

It is generally agreed that an infected hæmothorax needs the same treatment by chemotherapy, aspiration and tube drainage as an empyema not preceded by hæmorrhage. There is not, however, the same urgent necessity to remove sterile blood as to remove pus from the pleural cavity, and, though aspiration of hæmothoraces was advised in the last war[(1)] and has been considered advisable by the majority of surgeons since, there still exist advocates for the policy of non-interference with uninfected hæmothoraces which are slowly absorbing by natural means (for example, Smithy[(2)]). They believe that in such cases aspiration is unnecessary because the blood will ultimately be absorbed without it, and that it is merely meddlesome treatment which carries with it the risk of restarting hæmorrhage and the danger of introducing infection with the needle into the fluid which is seldom completely removed and is an excellent pabulum for organisms. They also maintain that the fluid is doing a useful job by splinting the damaged lung. It is therefore necessary to give the reasons why most surgeons believe that removal of the blood is the correct treatment.

It is true that an uninfected hæmothorax will absorb in time, but this is a slow process and in the case of a large hæmothorax may take many months. The blood acts as an irritant like any other foreign body, and causes an inflammatory response in the pleura. Inflammatory exudate seeps into the pleural cavity diluting the blood, and granulation tissue which soon starts changing to fibrous tissue commences to grow. Only later does absorption of fluid exceed exudation and the effusion begin to disappear, and its disappearance is very gradual because absorption can never be rapid through a barrier of comparatively avascular fibrous tissue. Great fibrous thickening and even calcification of the pleura may result, with prolonged or permanent respiratory disability.

On the other hand, when the blood is efficiently removed many patients will have a dry and healed pleura within a month with no respiratory disability remaining, and those who become infected will have a small loculated empyema instead of one coextensive with the original hæmothorax *plus* the added exudate. This reduction in volume of the effusion is important in all cases because all hæmothoraces with penetrating or perforating wounds must be regarded as potentially infected. Moreover, extravasated blood

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reduces the local resistance to infection, so that its early removal probably averts empyema formation in some cases.

Surgeons tackling hæmothoraces for the first time are sometimes worried about the danger of introducing infection by aspiration, especially in primitive jungle conditions with mud and sweat everywhere. This fear is liable to be strengthened when, as frequently happens, early aspirations yield sterile blood and later aspirations infected fluid. It is then natural to wonder whether the infection occurred by way of the aspirating needle; but it should be remembered that a latent period, which in these days of routine prophylactic chemotherapy with sulphonamides may exceed two weeks, occurs before organisms introduced at the time of wounding establish themselves sufficiently to enable a culture to be obtained from the fluid aspirated. Failure followed by success in the growing of cultures does not necessarily, and in fact seldom, mean that infection has been introduced at aspiration. With ordinary careful aseptic technique, the skin being cleaned with soap and water and painted with iodine, and the point or shaft of the needle never being touched, the danger of introducing infection is negligible—much less, for instance, than when a knee joint is aspirated. The pleura seems to be far less susceptible to infection than the synovial membrane of the knee. Fear of infecting the pleura is not a sufficient reason for avoiding aspiration of a hæmothorax. Army surgeons of the last war were of the same opinion.[3]

The risk that hæmorrhage will be restarted still looms large in the arguments of those against aspiration, but it has been grossly exaggerated despite authoritative statements to the contrary (Tudor Edwards,[4] Nicholson and Scadding[5]). The blood rapidly clots firmly in lung wounds, and the danger of recurrent hæmorrhage from damaged lung is extremely slight after twenty-four hours.

The argument that hæmothorax blood forms a useful splint for the damaged lung is possibly true, but the value of the splinting effect is dubious after the first few days, and during that period aspiration is usually confined to the removal of excess fluid which is causing undue pressure and mediastinal displacement. Those who advise early complete aspiration usually combine it with air replacement if the hæmothorax is large, air being an equally effective splint for the lung.

Thus all the arguments against aspiration can be refuted, and there appears to be overwhelming evidence in favour of the removal of the blood from a hæmothorax.

THE CLOTTING OF BLOOD IN THE PLEURAL CAVITY.

Blood in a hæmothorax clots in a peculiar way, and since this profoundly affects the means by which it may be removed it is pertinent to discuss it here.

Extravasated blood normally forms one large coagulum in which the fibrin contracts in one mass, holding most of the corpuscles in its meshes and squeezing out the serum; but blood in the pleural cavity is immediately diluted by pleural exudate, and the clotting of this diluted blood is different. It may be described as following one of three courses, the division into three being quite arbitrary.

1. It may scarcely clot at all, remaining completely fluid except for a few thin, short threads of fibrin, some floating freely and some adhering to the pleural lining of the cavity, giving it a granular appearance. These threads will pass through a wide bore needle so that aspiration of such a hæmothorax is easy.

2. A moderate amount of fibrin may be produced, partly deposited in layers with shaggy, semi-detached shreds on the whole pleural lining of the

cavity, and partly forming freely floating debris which tends to settle to the bottom. The free and partly detached pieces of fibrin in this type of case are larger and are liable to block the aspirating needle, but by aspiration above the sediment it is usually possible to remove most of the fluid. The remaining sediment and mural fibrin are diluted and partly lysed by more exudate which is removed at another aspiration a few days later. Ultimately all the fibrin disappears so that a series of aspirations leaves the pleural cavity dry. Thus in this type of case aspirations are difficult, but should be successful.

3. A large continuous coagulum of fibrin may be produced, not contracting and retracting into one mass like ordinary blood clot, but into the form of a coarse mesh, stretching from side to side of the cavity and enclosing loculi containing up to about three ounces of fluid. The loculi do not communicate and the fluid from different loculi in the same chest may be quite different in appearance. For instance, one may contain clear, straw-coloured, sterile fluid; another brown, turbid, sterile fluid; and another pus and organisms. Often the loculated clot is confined to the basal part of the hæmothorax. The upper part which remains fluid can then be aspirated, but satisfactory aspiration of loculated clot is impossible. At best only one or two loculi will be tapped after much prodding with the needle in various directions. To remove the fluid the clot has to be broken down mechanically, either through an open thoracotomy or through a cannula under thoracoscopic vision.

From the above facts it is clear that something in the pleura tends to inhibit clotting, more in some cases than in others. Whether this is a purely chemical phenomenon or whether physical factors such as respiratory and general body movement also play a part analogous to the whipping of blood as it clots to defibrinate it, is unknown. On the assumption that the normal behaviour of blood in the pleural cavity is to remain fluid, many causes for its clotting have been suggested. Nicholson and Scadding[2] have recently postulated the following causative factors: (*a*) delay in aspiration, (b) infection, (*c*) intrapleural foreign body, (*d*) much tissue damage.

Nicholson and Scadding state that infection is "not an important factor", but experience in New Guinea has led to the opposite view. The *Staphylococcus aureus* was the commonest infecting organism in New Guinea, probably because the hot, humid climate favoured its presence on the skin, and because it is able to survive routine sulphonamide therapy. In the presence of this organism a certain amount of clotting invariably occurred, and the rare cases with massive loculated clot were nearly always associated with staphylococcal infection, though its discovery was frequently preceded by a long latent period. Indeed, in this battle area one learned to suspect staphylococcal infection whenever massive loculated clot was found, and to wait fairly confidently for the expected culture when the latent period expired.

It is rare for a foreign body to enter the pleural cavity without bringing organisms with it, and part of the activity of intrapleural foreign bodies in promoting clotting may be due to the associated infection, even though it is sometimes only latent infection. Likewise delay in aspiration probably often acts by allowing time for latent infection to turn the scales in favour of clotting. Of the other causative factor Nicholson and Scadding state: "Much tissue damage would favour clotting and this is probably an important factor." They give no evidence in support of this view, and, while one cannot deny that it is probably one of the factors, doubt is cast on its importance since patients are seen with no infection but with extensive tissue damage in which clotting has been minimal.

CASE I.—L.W., a soldier, aged thirty-three years, provides an example of this condition. When a truck in which he was riding overturned down a precipice he received multiple

injuries which included fracture of the second to the eighth right ribs with a severely "stove-in" right side of the chest and right hæmopneumothorax. The skin of the chest was intact. There was an enormous amount of surgical emphysema which spread from the scalp to the knees, so that there was no doubt that the parietal and visceral pleura were both torn, probably extensively. There was also a moderate amount of blood-stained sputum in the first few days. Nevertheless the amount of blood in the pleura was small, probably because collapse of the lung, caused by the large pneumothorax, was so complete; and it did not clot. Aspiration was perfectly easy. Eleven ounces of bloodstained fluid were withdrawn on the third day and seven on the fifth day. One further aspiration of thirteen ounces of yellow fluid on the twenty-sixth day left the pleura dry.

Probably the most that can be said at present is that many factors favour the clotting of hæmothorax blood and that their relative importance varies in different cases. I do, however, believe that infection, even in its latent stage, is often an important factor.

METHODS OF REMOVING HÆMOTHORAX BLOOD.

Blood may be removed from the pleural cavity in one of the following ways: (i) during a thoracotomy, done primarily for some other reason; (ii) by early complete aspiration and air replacement; (iii) by repeated aspirations, the pleura usually being incompletely emptied at first, without air replacement; (iv) by intercostal tube, sometimes preceded by thoracoscopy; (v) by thoracotomy, done primarily to empty the pleura, and followed by immediate closure or by tube drainage.

As often happens when there are several ways of doing a thing, there is a time and a place for each. The above methods will be discussed in turn, with special reference to their relative value in jungle warfare such as has been experienced in New Guinea.

Removal of Blood during a Thoracotomy Done Primarily for Some Other Reason.

If a thoracotomy is done early for a war wound of the chest, the surgeon naturally avails himself of the opportunity to empty the pleural cavity. The indications for early thoracotomy are outside the scope of this paper. Except as an emergency measure to stop intrapleural bleeding which fails to cease spontaneously, the operation should be preceded by X-ray examination and be performed in a well equipped theatre with the assistance of an experienced anæsthetist, and at a place where the patient can be adequately nursed afterwards and need not be evacuated further for a few weeks. These facilities are available only at a general hospital or equivalent unit. In jungle warfare patients may take as long as two weeks to reach such a unit, and it is quite out of the question for medical officers along the line of evacuation to consider early thoracotomy for a non-urgent condition such as a large or dangerously situated foreign body. The emergency of persistent intrapleural hæmorrhage is rare among patients who survive to reach a medical post, and I know of no case in New Guinea in which hæmothorax blood was removed during an early emergency thoracotomy.

Early Complete Aspiration with Air Replacement.

Chandler[6] and F. R. Edwards and Morriston Davies[7] are recent advocates of the early complete aspiration with air replacement, the aim of which is to aspirate all the blood as soon as possible, within the first twenty-four hours if the patient reaches a centre where it can be done in that time, so as to minimize its irritative effects on the pleura, forestall intrapleural clotting and reduce the risk of infection. Complete aspiration of a large hæmothorax cannot be done at one sitting without air replacement because

the intrapleural pressure would become too strongly negative, causing collapse of the patient and tending, at this early stage, to restart hæmorrhage from the lung. The aspiration is done near the base while air is introduced through a pneumothorax needle in the second intercostal space anteriorly, so as to keep the average intrapleural pressure at about –2 centimetres of water. Normally it is about –12 centimetres of water. More fluid collects, but it is thin and can be aspirated at about three-day intervals. Towards the end of the first week it is safe and wise to begin to remove the air if it is not being absorbed rapidly enough, gradually making the intrapleural pressure more negative and aiming at having the lung fully reexpanded in not more than three weeks.

If clotting has already occurred so that reasonably complete aspiration is impossible, this method is inapplicable. It also has the disadvantage that the patient is liable to cough the air out through a torn parietal pleura into the chest wall, causing surgical emphysema and perhaps allowing the lung to reexpand too quickly. Moreover, the air in the pleural cavity keeps the upper part of the lung away from the chest wall and this apical air is the last to be aspirated or absorbed, whereas fluid without air collects at the base and allows the apex of the lung to expand and adhere to the chest wall. Air replacement therefore prolongs the period during which the pleural cavity remains generally open and delays obliteration and loculation, thus increasing the risk of a generalized empyema if sepsis occurs. Finally the procedure requires a pneumothorax apparatus and should be checked by radiological examination. It is therefore not applicable to front-line cases and was not used in New Guinea, though it does have a place in the treatment of some hæmothoraces, especially among civilian air-raid casualties who usually reach hospital within a few hours of wounding.

Repeated Aspirations, Usually Incompletely Emptying the Pleura at First, Without Air Replacement.

In the next method of treatment to be described aspiration is first done about forty-eight hours after infliction of the wound and repeated thereafter at about two- or three-day intervals until the pleura is dry, or, in the presence of infection or considerable clotting, until thoracotomy and drainage by tube are done. The amount withdrawn at each aspiration is not more than about 450 to 600 cubic centimetres. With this amount there is scarcely any danger of creating unduly high negative intrapleural pressures and therefore no need for air replacement. A hæmothorax which initially contains considerably more than 600 cubic centimetres of bloodstained fluid will not be emptied at the first aspiration, and it is usually wise to desist when about a pint of fluid has been obtained, even though more might come easily through the needle. There is no need for hurry. A sterile hæmothorax, even though very large, will usually be empty well within three weeks if this plan is followed and aspirations are successful. However, the times and amounts given are merely my own advice and are intended as no more than a general guide to be put on one side whenever the surgeon thinks fit.

Aspiration can be performed quite satisfactorily beside a jungle track, without removal of the patient from his improvised stretcher made by the native bearers, and without the help of radiological examination or a pneumothorax apparatus. Repeated aspiration is therefore the method of choice in an area like New Guinea, where the treatment of all hæmothoraces has been begun in this way.

CASE II.—Captain L.G., aged twenty-seven years, received a gunshot wound of the chest causing a left hæmothorax which was cured by repeated aspiration. The bullet entered through the second intercostal space anteriorly, traversed the left lung obliquely in a downwards, outwards and backwards direction, and came to rest under

the skin in the lower part of the left axilla. He coughed a little bloodstained sputum for three days and reached hospital on the fourth day. On the second day thirty ounces of bloodstained fluid were aspirated, and on the seventh day ten ounces of slightly bloodstained fluid. No further aspirations were required. The bullet was removed through a small incision under local anæsthesia. X-ray examination on the fifteenth day showed a faint opacity in the lung along the bullet track and slight blurring of the left costophrenic angle. In the fifth week the chest was radiologically clear. Breathing exercises had by this time restored full symmetrical movement of the chest, and as far as his chest was concerned he was ready for a short stay at a convalescent depot and then for return to his unit. But he also had benign tertian malaria and an anxiety state, for which he was evacuated to Australia.

Drainage by Intercostal Tube, Sometimes Preceded by Thoracoscopy.

For cases in which clotting prevents complete aspiration through a needle, those who advise early complete aspiration with air replacement usually also advocate the breaking down and aspiration of the clot through an intercostal cannula under thoracoscopic vision through another cannula.[7] A Roberts intercostal sucker fitting is most useful for this purpose. The pleural cavity is then closed with a large amount of air inside and treated afterwards by aspiration when necessary, or else it is drained at once by an intercostal tube to an under-water drainage bottle. Neither thoracoscopes nor Roberts's suckers were available in New Guinea.

Infected hæmothoraces can also be drained by intercostal tube, but unless the clots are removed first by thoracoscopy as described above, this form of drainage is less satisfactory than in ordinary empyema. Intercostal tubes can be troublesome to manage at the best of times, but when they are repeatedly being blocked by pieces of hæmothorax clot which are being detached from the wall of the cavity from time to time and falling to the bottom, they are practically hopeless. By constantly taking measures to clear the tube, and even by putting two intercostal tubes into the same cavity, as was done in one Australian hospital, so that while one is being cleared the other is probably functioning, the troubles can be surmounted, but this seems to me to be making a fetish of intercostal drainage. When one considers that the removal of a small portion of rib causes no immediate nor permanent disability and allows one to make an initial clean sweep of the contents of the cavity and to see its interior, and thus to gain information which may help in subsequent treatment, it hardly seems worth while troubling with an intercostal tube, especially when a thoracoscope and sucker are not available to empty the hæmothorax first. Also an intercostal tube inserted among clots violates a principle of drainage of empyemata—namely, that the tube should completely empty the cavity at once and then keep it empty.

However, when a hæmothorax contains a large amount of thin fluid and not much clot, but enough to make aspiration difficult, closed drainage by an intercostal tube may be useful as a temporary measure, especially if the patient is very ill and it is unwise to remove him to the theatre and safer not to let atmospheric pressure into his pleura, even for a short time. Thus it can be a very useful method for a patient with bilateral infected hæmothorax before loculation by fibrous adhesions has occurred. But it should be done with the intention, if the drainage by the intercostal tube is not completely satisfactory, of following with a rib resection later when loculation has occurred and the patient's general condition is better.

As a temporary measure for infected hæmothoraces on the line of evacuation intercostal drainage is disappointing because the tube and drainage bottle need far more attention than can be given while the patient is travelling. It is usually better to continue repeated aspirations of the bloodstained pus until the patient reaches hospital, where he will probably be drained transcostally.

The following case illustrates the value as a temporary measure of intercostal drainage of an infected hæmothorax.

CASE III.—Lance-Corporal W.W., aged thirty-eight years, received wounds in the chest from two machine-gun bullets. One entered over the middle of the left clavicle, shattering this bone, and passed obliquely downwards, backwards and medially through the left lung to lodge under the skin near the spinous process of the ninth dorsal vertebra. It caused a complete left brachial plexus lesion and a left hæmopneumothorax. The other entered through the right second rib, fracturing it near the costo-chondral junction, and passed backwards, downwards and slightly outwards to lodge in three small pieces in the muscles of the right chest wall near the angle of the scapula. The bullet had presumably been fragmented by an impact with something before it entered the chest, and the three pieces of metal appeared to represent most of its casing. They caused a right hæmopneumothorax. Both entry wounds sucked, but they were sutured on the field by a regimental aid post orderly within a quarter of an hour of the wounding. The patient was carried for three days by native bearers to an aerodrome and evacuated to hospital by air, rising 8,000 feet, on the fourth day.

On arrival in hospital he was very dyspnœic and both hæmothoraces were infected. He appeared to have managed to survive by coughing most of the air out of both pleural cavities, causing considerable surgical emphysema. A blood transfusion of 600 cubic centimetres was given, and thirteen ounces of bloodstained fluid were aspirated from the left chest. Then the needle blocked. The fluid was sent for examination by culture methods. The wound in the right chest was septic and the sutures were cutting out, so they were removed. Much bloodstained pus immediately began to escape with each expiration. As the patient seemed to be able to stand this wound being open and was unfit for any operation, I merely covered it with a dressing.

On the following day—that is, the fifth day—the orderly in the laboratory reported "streptococci" in the culture of the fluid from the left chest. We were in a camp hospital with nearly 300 ill patients and only three medical officers, who were responsible for everything including the X-ray and pathology departments, and I had no time to diagnose what sort of streptococci were present. I decided to drain the left pleural cavity intercostally because aspiration on the previous day had been unsatisfactory owing to clots, and thoracotomy would have been dangerous with the right empyema already open. The intercostal tube was inserted through a cannula in the seventh space in the posterior axillary line and connected to an under-water drainage bottle. The patient was so ill that the fluid had to be let out very slowly. We kept the tube clipped except for a minute or two every hour. At the end of twelve hours three pints had drained through the tube and the pleura seemed empty, so that the tube was then left unclipped. Two more pints drained in the next three days. On the sixth day a second blood transfusion was given. By the tenth day X-ray examination showed a small loculated empyema in the right mid-zone anteriorly which seemed to be draining moderately well through the entry wound, and the left lung was almost fully expanded with an opacity in it along the bullet track. On the fourteenth day suction of −2 inches of mercury was applied to the intercostal tube. By the twenty-first day drainage through the tube had ceased and X-ray examination revealed a small residual loculus at the base of the left lung posteriorly—that is, about three inches medial to the tube, which was in the posterior axillary line. The next day, therefore, the intercostal tube was removed, and under local anæsthesia the loculus was opened by resection of portion of the ninth rib and another closed drainage tube was inserted. Suction was started again two days later. The patient was now sitting out of bed each day and the right empyema cavity was obliterated, though there was still a small sinus leading to the fractured right second rib. The fracture of the left clavicle had united.

The patient had had slight diarrhœa from time to time, and on the twenty-eighth day he suddenly developed acute bacillary dysentery. The drainage tube was cut short and the dysentery was treated with sulphaguanidine. A week later he was returned by hospital ship to Australia. I heard that his chest made a complete recovery, but I do not know the extent of return of function in the left arm.

Thoracotomy Done Primarily to Empty the Pleura, and Followed by Immediate Closure or Tube Drainage.

For Infected Hæmothoraces.—In the past it has been extremely rare for infected hæmothoraces to be cured by aspiration alone, but one recent case of cure in this way has occurred in the Australian Army with the help of penicillin. This new drug opens up possibilities which have not yet been fully investigated, but it is unlikely that it will do more than reduce the percentage of cases of hæmothorax which become infected and perhaps also the

percentage of infected hæmothoraces which will need tube drainage. In the circumstances it seems better to describe what has been done in the past without the aid of the drug.

When a patient with a hæmothorax reaches hospital he is examined clinically, and his chest is examined by X rays and aspirated. Some of the aspirated fluid is sent to the laboratory. If pus and organisms are found in it, it is best to institute transcostal drainage at once, except when intercostal drainage is indicated as described above. A small portion of a rib is resected at a suitable spot, the fluid and clot in the pleural cavity are completely evacuated, and a drainage tube is inserted. Except when the cavity is very small, say, not more than about three inches in diameter, closed drainage is preferable, and the tube is connected to an under-water drainage bottle. Thereafter the treatment is the same as for any empyema drained by a tube. Suction drainage is usually commenced a few days later, but this is beyond the scope of this paper, which is only concerned with the cases until the last of the blood and its clot have been removed.

The following case illustrates thoracotomy and tube drainage for an infected hæmothorax.

CASE IV.—Private S.T., aged twenty-two years, received a perforating gunshot wound of the right side of the chest, the entry being posteriorly medial to the vertebral angle of the right scapula, and the exit through the third intercostal space anteriorly in the nipple line. The exit wound sucked and was sutured. On the second day he was given 600 cubic centimetres of serum intravenously and 600 cubic centimetres of blood, and on the fourth day his chest was aspirated, but the amount of fluid obtained was not recorded. For the next six days he was carried by native bearers over slippery jungle tracks through mountainous country and on the eleventh day he was flown to hospital. Some diarrhœa had occurred during the journey, and on admission the stools were still loose, containing mucus but no blood. Examination by culture methods for dysentery organisms gave a negative result. There was a large right hæmothorax, but only three ounces of bloodstained fluid could be aspirated and only two ounces three days later on account of clots. Both specimens were sterile on incubation. At this stage treatment of the chest was delayed by a sudden exacerbation of the diarrhœa, with blood and mucus and a dysenteric exudate in the stools and a temperature of 104° F. This was treated with sulphaguanidine. On the twentieth day seven ounces of fluid containing *Staphylococcus aureus* was aspirated posteriorly. The diarrhœa had improved, so on the twenty-second day portion of the ninth rib was resected posteriorly and a loculated pleural cavity was opened containing much clot and about ten ounces of pus. It was cleaned out and drained by an under-water tube, to which suction was applied a week later.

In the meantime a definite anterior loculus of pus had appeared and begun to point at the exit wound. Aspiration of it failed because of clots. At each expiration the healed exit wound bulged, so it was reopened under local anæsthesia and about five ounces of thick pus and clots were allowed to escape. Then a tube was inserted through the incision, and therefore intercostally, and connected to a second under-water drainage bottle, to which suction was also applied a few days later. This treatment of the anterior loculus was foolish. It would have been much better to have resisted the temptation of the bulging exit wound scar and to have resected a piece of rib and cleaned the cavity out properly. The result was that three weeks later I had to resect portion of the fourth rib and to put in another tube at the bottom of the loculus, which was not draining properly. In the meantime the patient had had a severe attack of benign tertian malaria and a relapse followed four weeks later. However, the cavities gradually healed, and four and a half months after the receipt of the wound the chest was restored to normal. Breathing exercises had restored full movement and symmetry and there was no residual respiratory disability whatever.

In the following case the patient had a thoracotomy for the removal of loculated clot.

CASE V.—An officer received a perforating gunshot wound of the right side of the chest causing a right hæmothorax with loculated clot and *Staphylococcus aureus* infection, and died of ulcerative endocarditis nine weeks after injury. The bullet entered in front of the right shoulder and passed obliquely backwards, medially, and downwards, through the axilla and chest, missing the humerus, but causing median and ulnar paralysis, and traversing the right lung to an exit medial to the vertebral border of the right scapula below its spine. The exit wound sucked and was sutured. A large

hæmothorax collected and pushed the air in the pleural cavity into the chest wall, causing surgical emphysema. There was a small amount of bloodstained sputum.

The patient had one aspiration of thirteen ounces of deeply bloodstained fluid on the second day and reached a general hospital on the eighth day with a temperature swinging from 100° to 103° F. and a complete "blackout" of the right side of the chest with the heart displaced one inch to the left. On the ninth day fourteen ounces of bloodstained fluid with no offensive odour and sterile on incubation were aspirated high up in the axilla. Aspiration at a lower level failed. His hæmothorax obviously had a capacity of pints and this quantity of fourteen ounces was but a fraction of the fluid floating above a large mass of clot. In view of the large amount of clot and his pyrexia, I suspected staphylococcal infection, despite the fact that the fluid aspirated was sterile, and I told my assistant that I intended to do a rib resection on the next day. He felt that this was rather drastic, and argued that this ought to be the type of case in which a course of sulphathiazole would control the incipient infection. I have found this drug useless in this type of case, but I agreed to his giving a full course of it by mouth, and the course was started at once. At the time I thought that the patient's chances would not be unduly prejudiced by this.

On the thirteenth day, after an attempt in two places, only four ounces of bloodstained fluid could be aspirated, but it grew *Staphylococcus aureus* in culture. Aspirations on the seventeenth day yielded only two ounces of fluid, which was again sterile.

The course of sulphathiazole (36 grammes) was finished and the patient no better, so on the twentieth day one and a half inches of the ninth rib in the scapular line was resected under local anæsthesia, the pleura was opened, and a vast amount of clot and two pints of pus were removed. As the clot was broken down, it could be seen that the fluid in some of its loculi was frank pus and in others clear and straw-coloured. The right lung was collapsed into a small mass against the mediastinum. A tube was inserted and connected to an under-water drainage bottle. The daily drainage for the first ten days was 54, 24, 8, 6, 7, 7, 10, 6, 5 and 5 ounces respectively. Thereafter it was usually only one or two ounces. On the ninth day after operation suction was started at a pressure of one inch of mercury and increased every two or three days until it reached a pressure of three inches of mercury, and in the fifth week after operation the tube was replaced by a smaller one cut short and left open until death occurred a few days later.

When admitted to hospital the patient was emaciated and exhausted by weeks of front-line strain, and during his illness he developed benign tertian malaria and a glazed tongue, angular stomatitis, and spongy gums suggesting vitamin *B* and *C* deficiency, for which treatment was given.

In the third week after drainage of the empyema he developed a left femoral thrombosis which subsided at first, but then extended further two weeks later, and in the sixth week he developed signs of septicæmia with a positive blood culture for *Staphylococcus aureus*, and he died four days later, just under nine weeks after being wounded.

One wonders whether generalization of the staphylococcal infection might have been averted by earlier operation. At this time penicillin was not available in New Guinea.

At post-mortem examination ulcerative endocarditis with destruction of one cusp of the mitral valve, and soft, mushy clot extending from the left femoral vein into the inferior *vena cava* were found, but there were no metastatic abscesses. The chest was most interesting. Despite the severe toxæmia which might have been expected to delay healing, the bullet track in the lung was completely healed and the lung was completely expanded, except where the small residual slit-like empyema cavity remained posteriorly. It was empty, but could not have accommodated more than about two ounces of fluid. The whole of the remaining visceral and parietal pleura of the right lung appeared absolutely normal, even to the extent of having its normal glistening sheen. A few thin filmy adhesions, which seemed to be in the process of being absorbed, remained, but even these gave no inkling of the acute inflammatory process which it was hard to believe had been there a few weeks previously.

For Sterile or Apparently Sterile Hæmothoraces.—There are two types of sterile hæmothorax which may need thoracotomy. The first is the type with massive loculated clot which cannot be removed through a needle. It has been pointed out that many of these hæmothoraces are in the stage of latent infection. There is a tendency to wait and see whether they are really infected or not, persisting meanwhile with inadequate aspirations. As soon as a positive bacteriological report on the fluid is returned there is no excuse for

delaying operation, but the question is how long one should wait for such a report, and whether a rib should ever be resected when the hæmothorax is really sterile. The fear of producing a generalized empyema which used to deter surgeons from operating in these cases in the days when open drainage of the pleura was the routine, has been removed by recent improvement in the technique of closed and suction drainage, which can now be relied upon to reduce a large pleural cavity to a small residual loculus in a short time. Uninfected loculated clot, if left alone, may gradually break down, but some of it will be organized. In my opinion this should not be allowed to occur, and if a patient, after about ten days of attempted emptying by aspirations, appears clinically to have a large loculated clot within the pleural cavity, that clot should be removed forthwith, infection or no infection, and there should be no hesitation in removing a piece of rib for the purpose. The pleural contents are completely evacuated and the wound is closed, with or without drainage.

If some of the loculi broken down at operation contain obviously infected fluid, even in the absence of a pre-operative positive culture from the fluid aspirated, a tube must be inserted. If one is doubtful about the presence of infection, it is still wise to drain by tube. If, however, there is no reason to suspect infection from the appearances at operation, the wound may be closed without drainage. In that case the air trapped in the pleura is aspirated by means of a pneumothorax apparatus before the patient leaves the operating table. Those who use gas anæsthesia may instead get the anæsthetist to expand the lung by positive pressure just before the last stitch to close the pleura is tightened. Post-operatively a small amount of fluid always collects which, together with any air left behind, should be aspirated at intervals until the pleura is dry.

The second type of sterile hæmothorax requiring thoracotomy is the occasional one which reaches the chronic state recently described by Smithy.[2] Treatment by repeated aspirations goes well for the first two or three weeks and there seems to be little, if any, loculated clot, but instead of the pleura becoming completely empty and dry in the third or fourth week, a residual loculus with thick fibrous walls forms in which brownish or yellow fluid persists in collecting in small amounts for months. For some unknown reason fibrinolysis has virtually ceased inside such loculi, and the balance between exudation and absorption of fluid fails to switch over in favour of absorption. If by the fifth week in the treatment of such a case this state of affairs has been reached despite efficient aspirations, time will only be wasted by continuing the aspirations. The cavity should be opened by rib resection and cleaned out. It will be found to contain very degenerate, brownish-grey, friable clot. It is then usually closed without drainage and aspirated post-operatively until it is dry.

In the following case the patient had a hæmothorax which reached the chronic persistent state.

CASE VI.—Private N.L., aged twenty-three years, received a penetrating gunshot wound of the left side of the chest. A small fragment of metal, probably part of the casing of the bullet, entered just below the middle of the left clavicle and came to rest in the mediastinum just in front of the arch of the aorta. It was not removed. There was a large left hæmothorax. Evacuation was by native bearers for six days and aeroplane on the seventh day, so that the patient reached hospital one week after being wounded. He also had malignant tertian malaria. The treatment of the hæmothorax was as follows. On the line of evacuation twenty-four ounces of bloodstained fluid were aspirated on the second day, six ounces were aspirated on the fourth day and two ounces on the sixth day. The last two aspirations were unsatisfactory, probably because too small a needle was used. In hospital fifty-four ounces of bloodstained fluid were aspirated on the eighth day (without the production of any dyspnœa or feeling of tightness), twenty-four ounces were aspirated on the tenth day, ten ounces

of brownish fluid on the twelfth day, two ounces of very thick brown fluid containing small shreds of fibrin on the fourteenth day, and eleven ounces on the eighteenth day. On the twenty-first, twenty-third and thirty-third days only between one and two ounces of brown fluid could be obtained, and X-ray examination showed a persistent small loculated basal effusion. The fluid at every aspiration was sterile on incubation.

It was clear that the residual hæmothorax had reached the chronic state and that the final healing of the pleura would only be delayed by persisting with aspirations. Therefore on the forty-fifth day portion of the ninth rib in the scapular line was resected subperiosteally and the cavity opened. Its capacity was about half a pint. It was nearly full of very degenerate clot, which was removed, and it was lined by firm fibrous tissue. The patient had been running a slight temperature probably from some other cause, but I was not certain that there was no infection, so I put in a drainage tube, connected it to a water-seal bottle, and applied suction three days later. A culture of the fluid removed at operation contained *Staphylococcus albus*, but it was probably a contaminant because there were very few pus cells and no organisms in the direct smear, and no pus formed post-operatively. It would therefore have been safe to close the thorax without drainage. On the eighth day after operation lipiodol showed the cavity to be reduced to a tiny pocket about half an inch in diameter at the end of the tube track. We changed to open drainage with the tube cut short and evacuated the patient to Australia. I do not know the subsequent history, but I would expect the tube to have been out and the pleura and operation wound to be healed two weeks after operation.

MANAGEMENT OF HÆMOTHORACES IN NEW GUINEA.

The following brief outline will show how treatment by repeated aspirations fits into the general plan for dealing with hæmothoraces in New Guinea.

Any wound which is sucking or allowing hæmothorax blood to escape is sutured at once, usually without anæsthetic or excision and frequently by the stretcher-bearers on the field. The patient is carried via the regimental aid post to the advanced medical post of the field ambulance. This post is usually not more than two to four hours' carry from the front line. The surgical team attached to it takes charge of the chest cases.

Treatment is at first expectant. The patient is rested semi-recumbent, and given morphine to relieve pain and restlessness. Oxygen is not available. His colour, pulse, breathing, position of apex beat, chest signs and wounds outside the chest are noted with as little disturbance to him as possible. But he must be moved enough for the medical officer to inspect every wound he has, to make a clinical estimate of the amount of bleeding into the pleural cavity, and especially to detect whether a tension pneumothorax is present. The bleeding into the pleural cavity, whether from lung or chest wall, nearly always soon ceases because the patients with vigorous hæmorrhage have already been segregated by death on the field. The cardio-respiratory apparatus meanwhile accommodates itself to the changed physical conditions within the chest and to the loss of blood, so that a state of equilibrium is reached. So long as the patient appears to be achieving that state of equilibrium, nothing active is done in the first twenty-four hours. He stays overnight at the medical post. Routine prophylactic sulphonamide therapy, begun at the regimental aid post, is continued.

Rarely equilibrium is not reached. The pleural contents go on increasing until they displace the mediastinum far to the opposite side and threaten death from vital incapacity. If this is due to a tension pneumothorax the tension is released through a needle in the second intercostal space anteriorly, but it may be due to continued hæmorrhage, probably from the internal mammary or a large intercostal vessel. In that case a blood transfusion must be started at once and enough of the blood aspirated from the chest to relieve the dyspnœa. If the bleeding continues, aspiration may have to be repeated in a few hours. One is then virtually putting blood in by transfusion and taking it out by aspiration; but, when proper facilities are not available for

thoracotomy, it is worth while doing this because the hæmorrhage may still stop of its own accord. If it does not stop, one is driven, however inadequate the facilities may be, to do a thoracotomy, evacuate the blood in the pleura, and search for and tie off the bleeding points.

Sometimes shock and hæmorrhage from associated wounds make necessary transfusion of blood or serum or both as a life-saving measure; but unless transfusion is really necessary it is best avoided in the first twenty-four hours for fear of overtaxing the already embarrassed pulmonary circulation or delaying the arrest of hæmorrhage from the chest wall. Likewise operations for other injuries are usually best avoided at this stage. For instance, a compound fracture of the humerus is a common associated lesion, frequently caused by the same missile as the hæmothorax, but routine excision of the arm wound is deferred if it is judged that the danger to life of leaving it is less than the probable mortality of immediate operation. However, injuries such as abdominal wounds with perforation of the gut or gas gangrene of a limb demand immediate operation, despite the state of the chest, if there seems to be a chance of saving the patient's life.

As on the day of injury, so on the first day after injury, treatment of the chest is as a rule expectant. The less the patient is disturbed, the better; but if there is too much dyspnœa and displacement of the apex beat, some of the blood will have to be aspirated. The second night is also spent at the advanced medical post. On the following morning—that is, about forty-eight hours after infliction of the wound—the average patient is prepared for further evacuation and has his first chest aspiration and perhaps a blood transfusion, given slowly. The period of immediate danger is usually at an end, and from now on the dual aim is to get ahead with the removal of the hæmothorax blood and with the transfer of the patient to hospital. It is found that these patients travel surprisingly well in the first week, but are liable to be less fit to move later if the hæmothorax is infected. The optimum time for evacuation should not be missed because the infected patients are the most in need of hospital treatment. However, some patients will be better left at the advanced post for an extra day or two if the tactical situation permits. Each case calls for individual judgement as to the patient's fitness to travel.

In New Guinea the first part of his journey is usually by carriage by native bearers on an improvised stretcher. This may take several days. In one part of the campaign it took six days to reach the nearest airfield. Medical posts where the patients stay overnight are distributed along the track at distances which take the bearers about six hours to cover, and during the daily carry the patient is in the sole charge of the natives. In some areas evacuation is in barges or other small craft in daily stages between coastal medical posts. The last stage to hospital is frequently by air. At each staging post the medical officer has to decide whether a further chest aspiration or blood transfusion is necessary before the patient moves on. Ordinarily chest aspiration is repeated every two or three days, and is continued at intervals after the patient reaches hospital until the pleura is dry or until tube drainage is necessary. At hospital, breathing exercises are given to restore full functional capacity.

Such is the general outline of treatment of hæmothorax by repeated aspiration as practised in New Guinea, where all patients are treated in this way in the early stages. If sepsis develops in the pleura, tube drainage is usually necessary, but as a rule it is deferred until the patient reaches hospital. Discovered or suspected infection is taken as an indication for the quickest possible evacuation to hospital, aspirations being continued on the journey. Massive loculated clot cannot be aspirated, but the free fluid which

collects above it can be aspirated during the period of evacuation; and since loculated clot is often associated with latent infection, it is another indication for speedy transit to hospital.

PRACTICAL POINTS IN TREATMENT BY REPEATED ASPIRATION.

Apparatus.

The needle must be of adequate bore and length. I use one of 14 B.S.W.G. (British standard wire gauge) and four and a half inches long, and advise against anything narrower, though three inches would be long enough for most cases. Fluid should never be left unaspirated because an unsuitable needle has been used. With a pointed scalpel a tiny nick for the needle should be made in the skin. The needle is best used with a two-way tap ("Record" fitting) and a 20 cubic centimetre "Record" syringe. A 10 cubic centimetre syringe is more tiresome to use because double the number of syringefuls have to be withdrawn, and one larger than 20 cubic centimetres is unsatisfactory because it requires too much pull on the plunger. The plunger should be of metal. Glass plungers stick. The syringe should never be used without a two-way tap, because while it is being detached from the needle to be emptied and while it is being reconnected, the needle is liable to be jerked out of position, and, if the intrapleural pressure is negative, it is impossible to prevent air from entering. A small hæmothorax may be converted into a huge generalized pneumothorax in this way despite all possible care to close the butt of the needle with the thumb while the syringe is detached, and, if infection occurs, the result is a generalized empyema. In such a case it would have been better to have left the patient alone rather than to have carried out aspiration in this inefficient way.

With a syringe and two-way tap it is impossible to suck the fluid out too quickly. Also, while pulling on the plunger of the syringe, one can feel what is going on at the point of the needle in a way which cannot be described but is immediately appreciated while doing the job. It is as if one's "mind's eye" were projected to the needle point. If a floating piece of fibrin gets partly sucked into the bevel it can be cleared by injecting a small bubble of air. A suction apparatus of the Potain type has none of these advantages and is more cumbersome and more liable to mechanical failure. A suitable two-way tap should therefore be available at every medical post.

When to Repeat Aspiration.

Aspiration is repeated roughly every three days until the pleura is dry, but the interval is varied to suit each case and usually becomes longer as the effusion becomes smaller. The factors to be considered when deciding for or against another aspiration on any particular day are the clinical findings and the way in which the patient is to spend the day. In the early stages of a large hæmothorax the important thing to estimate is the patient's reserve vital capacity, which must be judged adequate for the next twenty-four hours before a decision against aspiration on that day is made.

As the pulmonary circulation is almost at a standstill in collapsed areas of the lungs, nearly all the blood from the right side of the heart has to pass through the portions still aerated where there is consequently a tendency to vascular engorgement. When the vital capacity is reduced to a critical level from pressure of an effusion, and failure of compensatory mechanisms is imminent, moist sounds will be heard at the base of the good lung owing to engorgement in the failing pulmonary circulation. If some of the effusion is not aspirated immediately, compensation will suddenly break down and the patient will die, probably within half an hour, of acute pulmonary œdema. One must beware of delaying aspiration till a crisis of this sort occurs.

If the patient is to travel he must have a reasonable reserve of respiratory capacity so that he will be able to accommodate in his chest the effusion of fluid which will be added to the blood in the interval before he reaches the next medical officer. If his journey is to be by air, further allowance must be made for the relative reduction in vital capacity due to lowered oxygen tension at high altitudes, and for the actual reduction, if a pneumothorax is also present, due to the expansion of the intrapleural air at lower atmospheric pressures. Theoretically it would be better to avoid altitudes higher than 2,000 feet, but in New Guinea patients frequently had to be flown at 8,000 feet in order to cross the mountains, and no deaths occurred as a result of this.

Clinical estimation of respiratory reserve is difficult and comes only with experience. The most helpful signs are the amount of dyspnœa, the degree of displacement of the apex beat, and whether there are moist sounds in the opposite lung. The presence of cyanosis and the physical signs on the affected side of the chest may influence the decision, but they are not so helpful. The former may be masked by pallor, the latter by surgical emphysema; and it is impossible to distinguish clinically between cyanosis due to incomplete oxygenation of the blood and therefore indicative of the need for aspiration and the blue skin colour due to the methæmoglobinæmia and sulphhæmoglobinæmia associated with routine prophylactic sulphonamide therapy. As a safe rule, if in doubt about the adequacy of the respiratory reserve, aspirate, daily for a few days if necessary.

After a large hæmothorax has been reduced by aspiration to a small size, and at all times with small hæmothoraces, the vital capacity is well above the critical level and there is no need to worry about it. The aim of repeating aspiration is then to get the pleura dry within a reasonable time—that is, about three weeks from the time of injury. It is better to wait three or more days between aspirations, partly to avoid unnecessarily frequent disturbance of the patient, and partly to allow a fair amount of lysis of the remaining fibrin. It is impossible to hasten beyond a certain optimum speed the attainment of an empty pleura which remains dry, and it is better for the patient to have, for example, an aspiration of twelve ounces of fluid in three days' time than four ounces of fluid each day. In infected cases in which the conditions are not suitable for tube drainage, aspiration will tend to be carried out more frequently because in them fluid collects more rapidly and frequent aspiration will diminish the toxic absorption.

The Choice of Site for Aspiration.

It is a common fault to carry out aspiration at too low a level. The needle should rarely be inserted below the ninth intercostal space just medial to the angle of the scapula, the eighth just lateral to the angle of the scapula, the seventh in the posterior axillary line (usually the best to try first), the sixth in the mid-axillary line, the fifth in the anterior axillary line, and the fourth in the nipple line. These points are in approximately the same horizontal plane, and are higher than the sites usually chosen by inexperienced men, who often fail because the needle enters the phrenicocostal sinus and pierces the diaphragm. Failure of aspiration at the level indicated may be due to fibrin which has settled, and one should always try at a higher level—for instance, in the fifth or fourth space in the mid-axilla. This is a very good spot for drawing off thin fluid above basal clot.

When a hæmothorax becomes smaller and loculated, the site for aspiration is determined by the position of the loculus, which is shown by the physical signs and by antero-posterior and lateral skiagrams. Owing to the weight of the fluid and the patient's position in bed, residual fluid tends to form a loculus at the base posteriorly, but not infrequently a second loculus

is formed elsewhere. It is usually in relation to an entry or exit wound. For instance, if the entry wound is at the front and the exit at the back or *vice versa*, there will often be a loculus at the front in addition to the usual loculus at the back. There are two reasons for this. Firstly, damaged lung does not reexpand so readily as normal lung, so that there may be a stage between aspirations when the normal part of the lung has expanded to the chest wall and the damaged part has not. If the parietal and visceral pleura adhere where they are in contact, a loculus will be separated off with the damaged lung deep to it. The corresponding chest wall wound will be superficial to it because the chest wall and lung wounds were originally in contact as the track of the missile. Secondly, both the chest wall and lung wounds are a source of inflammatory exudate which escapes into the pleural cavity while they are healing, the more so if there is a compound fracture of the rib or if infection is present in either or both wounds, and loculation is more likely where the pleura is the last to heal and exudate is formed longest. Hence trouble from loculation in more than one place is commoner when the hæmothorax is infected. If these facts are borne in mind when a hæmothorax is being treated by a series of aspirations, one is on the look out for loculation when the hæmothorax is becoming smaller, and one knows where the loculi are likely to be. Each loculus must, of course, be aspirated separately.

The Amount of Fluid to be Removed at Each Aspiration.

My advice is to aspirate all the fluid which can be obtained if it is less than a pint, but as a general rule to refrain from removing more than a pint, especially if the aspiration is being done within two or three days of the injury. The reason for this limitation is to be found in a general principle of chest surgery—namely, that sudden and large changes in the degree of aeration or collapse in the lung should always be avoided if possible. The sudden change is just as dangerous when it is a reexpansion of previously collapsed lung, despite the fact that this is a return towards the normal. This is probably partly due to the sudden reopening of areas of the pulmonary vascular bed, but it also appears to be related to high negative intrapleural pressures. There seems to be a certain reluctance of lung which has been collapsed for some time by pressure from without, to reexpand, so that a negative intrapleural pressure much higher than normal may be resisted by an only partly reexpanded lung, even though there is still no significant thickening of its visceral pleura.

For this reason, when a large hæmothorax is aspirated, an unduly high negative intrapleural pressure is likely to develop after only part of the fluid is removed, and the critical pressure will be reached after aspiration of a smaller volume if it is withdrawn too quickly. Persistence with the aspiration is liable to cause the patient to collapse and die. If, however, the aspiration is stopped, the pressure will become less negative in the next day or two, partly owing to further exudation from the pleura, but partly also because of some ill-understood relaxation of the elasticity within the lung. The lung will then expand much further at the next aspiration in response to a negative pressure no greater than at the previous aspiration. Added to this, one is dealing in these cases with a damaged lung in the process of healing, and therefore a lung in which it is unwise to create undue elastic tension.

If, as advised, no more than about a pint of fluid is withdrawn at a time, the possibility of a dangerous negative pressure being produced is remote; but with larger volumes the danger exists and must be watched for. Fortunately a manometer is not necessary to show it. The condition is unmistakably indicated by the patient experiencing a terrifying sensation of shortness of breath and extreme tightness and even pain in the chest. At the

first inkling of this sensation the aspiration should stop. If the sensation does not then pass off within a minute or two it can be relieved by letting a little air in through the needle before it is withdrawn.

Aspiration of a Hæmopneumothorax.

The majority of traumatic hæmothoraces contain some air at the outset, either from the exterior through a sucking wound or from the bronchial tree through a tear in the lung. The sucking wound is always sutured, and the air leak in the lung usually seals rapidly. The air is then absorbed in a few days. Often much of it is coughed out into the chest wall and surgical emphysema is caused. In the treatment of a hæmothorax by repeated aspirations any air present can therefore usually be ignored. Occasionally towards the end of an aspiration some of the air appears in the syringe when the fluid level falls below the point of the needle. The aspiration of air can then with advantage be continued until no more can be obtained or until the patient experiences the sensations which indicate that the intrapleural pressure is becoming too negative.

The occasional patient who at the outset develops a tension pneumothorax due to a valvular opening into an air passage must be relieved by a needle inserted through the second intercostal space anteriorly and left open to the atmosphere or, better, connected by a tube to a water-seal bottle. Usually the opening ceases to be valvular and is sealed within a few hours. The needle is then withdrawn and the patient is treated as if this complication had not occurred.

SUMMARY.

1. The reasons for removing the blood from a hæmothorax are given.

2. The strange ways in which hæmothorax blood may clot are described, and the theories to explain the clotting are discussed.

3. The various ways in which hæmothorax blood may be removed are discussed.

4. A brief outline of how hæmothorax patients have been treated in New Guinea is given.

5. Important practical points concerned in the aspiration of hæmothoraces are described.

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A REVIEW OF THE PRESENT SURGICAL TREATMENT OF PEPTIC ULCER, AND CARCINOMA OF THE STOMACH.[1]

By J. B. G. Muir,
Hobart.

Probably no disease has resulted in such a number of articles and papers during the last three decades as peptic ulceration, and it is apparent that a decided increase in the incidence and mortality of the disease is occurring. Thus even ten years ago Wilkie pointed out that peptic ulcer admissions to the wards of the Edinburgh Royal Infirmary had increased 100% during the preceding twenty years, and Jennings has recently demonstrated a great increase in perforated ulcers in young men both in England and on the Continent. In a recent paper, Tidy has shown that the mortality rate for males over forty years of age suffering from peptic ulcer has increased strikingly in England. From a consideration of numerous statistics it appears that peptic ulcers now occur in approximately 2% of the population as a whole and with about the same frequency in persons admitted to general hospitals. They are also encountered in about 9% of all post-mortem examinations (Present).

Controversy on the results of medical *versus* surgical treatment in this disease has waxed and waned ever since Wölfler initiated the latter by performing the first gastro-enterostomy in 1881 in Billroth's clinic for an obstructing pyloric neoplasm, and as internists and surgeons tend to see each other's failures, viewpoints tend to become biased. This is well exemplified by Tidy, who (in 1936) after reviewing the results in large numbers of cases of peptic ulcer treated either medically or surgically in England and America, concluded that both methods gave approximately the same late results, when they were judged by the frequency of failure to relieve completely symptoms, relapses, and impairment of the patient's wage-earning capacity. He also pointed out that in addition surgical treatment carried an operative mortality higher than generally believed, especially in cases of gastric ulcer, in which it might rise to between 10% and 20%. Nielsen, however, has shown that when a peptic ulcer has been present for more than five years, cure by medical means will not be obtained in more than 10% of cases, and Conybeare has pointed out that the longer the period of observation after medical treatment, the smaller will be the proportion of cures. From numerous recent military reports it appears that the development of ulcer symptoms constitutes one of the common causes of invalidism in the services, and that in the majority of such cases a long history of dyspeptic troubles in civilian life is present. In other words, any patient suffering from a chronic peptic ulcer, even if well controlled medically, is liable to a relapse the moment his regime and diet are changed.

Nevertheless, probably some 80% of peptic ulcer patients receiving efficient medical treatment are symptom free on discharge from hospital (Cutler), and provided they avoid contributory causes such as alcohol and tobacco and are not subjected to mental worry or anxiety, can live a useful economic life.

[1] Read at the annual Tasmanian meeting of the Royal Australasian College of Surgeons on September 30, 1944. Accepted for publication on November 6, 1944.

Certain complications, however, arising during medical treatment present definite limits to its sphere of effectivity. These are perforation, so-called "mass hæmorrhage" from a chronic ulcer, hour-glass stomach, and pyloric obstruction. Furthermore, the now generally accepted view that 10% of chronic gastric ulcers undergo malignant change, and the fact that in a number of cases of chronic duodenal ulceration there is uncontrollable pain which does not respond to any form of medical treatment, are definite indications for surgical treatment.

A fact which has particularly impressed me has been the high incidence of peptic ulcer among hospital out-patients, as compared with private patients, and I have noted this not only in England and Australia but also in China, where the disease is not uncommon. It is essentially this "wage-earning" class of patients who, if medical treatment has failed to prevent recurring periods of work incapacity through relapses, cannot afford to persist in it and must seek relief through surgery.

Furthermore, one has noted that whereas duodenal ulcer, essentially the commoner type in males (4:1), affects most strata of society, gastric ulcer is far commoner in the poor. Probably not only hyperchlorhydria but the repeated "trauma" to the gastric mucosa in faulty feeding, with gastritis leading to ulceration, is responsible for this.

When such a patient is advised to undergo an operation for the relief of ulcer symptoms, he naturally wishes to know: (*a*) the risk to life involved; (*b*) the prospect of cure, that is, alleviation of symptoms and freedom from the likelihood of their recurrence; (*c*) his prospects of being subsequently able to earn his living.

I propose in this paper to review the indications accepted today for the surgical treatment of peptic ulceration and for the type of operation selected.

In order that we may see this problem from a local standpoint, I quote our own hospital figures and results, which, although few in number, will illustrate my remarks, as will also some photographs of specimens of gastric ulcer and carcinoma removed in operations for these conditions, here and in North China.

Table I shows the peptic ulcer admissions to three Australian general hospitals during the three-year period 1941 to 1944, together with the number of patients treated medically and surgically (included in the latter group are cases of acute perforated ulcer).

TABLE I.

Peptic Ulcer Admissions in Three Australian General Hospitals, 1941 to 1944.

Hospital.	Number Treated by Medical Means.	Surgical Treatment.		Total.
		Number.	Percentage of Total.	
Royal Melbourne Hospital	320	196	38	516
Saint Vincent's Hospital, Melbourne ..	122	127	51	249
Royal Hobart Hospital	152	54	25	205

The majority of Melbourne admissions are for cases of ulcer with complications. Owing to present bed shortage, patients with uncomplicated ulcer are treated as out-patients.

Table II is an analysis of the primary treatment of peptic ulcer patients at the Royal Hobart Hospital during the same period.

TABLE II.

Peptic Ulcer Admissions to the Royal Hobart Hospital, June, 1941, to July, 1944.

Observation.	Number of Cases.		Deaths.
Type of lesion:			
(*a*) Acute perforation	16	205	
(*b*) Chronic ulcer	189		
X-ray diagnosis:			
(*a*) Confirmed	170		
(*b*) Unconfirmed	19		
Medical treatment	132		Three (two from massive hæmatemesis and one undiagnosed leaking ulcer) (hospital mortality, 1·5%).
Surgical treatment:			
(*a*) Excluding perforations ..	20 (G.U.)[1] 18 (D.U.)	38	Two (one following gastrectomy and one following gastro-enterostomy) (hospital mortality, 6%).
(*b*) Acute perforations ..		16	Two (12·5%).
		54[2]	

[1] G.U. = gastric ulcer; D.U. = duodenal ulcer.

[2] Total number of deaths from surgical treatment, 4 (7·4%).

If we exclude those with acute perforation, we find that out of 189 patients suffering from chronic peptic ulcer, 38 were selected for surgical treatment, or 24·8%.

THE ABSOLUTE INDICATIONS FOR SURGICAL TREATMENT.

Let us first consider absolute indications for surgical treatment and then those of a relative type.

Perforation.

A perforated peptic ulcer naturally forms an absolute indication for surgical intervention as soon as possible, and it is interesting to note that since the pendulum has swung in favour of primary medical treatment for ulcer, hospital admissions for acute perforation have practically doubled (Pyrah).

An interesting fact brought to light by recent English papers is that periods of stress and anxiety are always associated with an increase in the number of perforating ulcers. Thus a series of figures for 1937 to 1940 from sixteen London hospitals shows that a remarkable increase took place during the two months of heavy air raids, September and October, 1940 (Stewart and Winser). It is suggested that the explanation of the rise is anxiety, with perhaps too much smoking and alterations in food habits.

Statistics show that the average patient with perforation, if operated upon within six hours and treated by suture alone with drainage, recovers, but that the mortality rises progressively should further delay in intervention occur. During the period under review, 16 patients with perforated gastric and duodenal ulcer were admitted to the Royal Hobart Hospital for surgical treatment, with two post-operative deaths—a mortality of 12·4%. Only two patients were subjected to gastro-enterostomy in addition to suture of the perforation, in each case because pyloric stenosis was feared.

The consensus of present-day surgical opinion is that the treatment in such cases should be limited to repair of the perforation by suture, reinforced if necessary by omentum, and to cleansing and drainage of the peritoneal cavity. One strong argument against the simultaneous performance of gastro-enterostomy, apart from the prolongation of operating time, is that perforation tends to occur more frequently in the younger group of ulcer patient,

the type generally associated with a high gastric acidity, in whom the risk of a future anastomotic ulcer is great. Furthermore, it is estimated that some 57% of patients with perforation remain subsequently free from symptoms (Ross), so that gastro-enterostomy would in any case have been unnecessary.

A number of patients with perforated ulcer do progress, however, and I have performed partial gastrectomy recently in two cases—one two years after suture of a perforation, for a large lesser curve ulcer which had

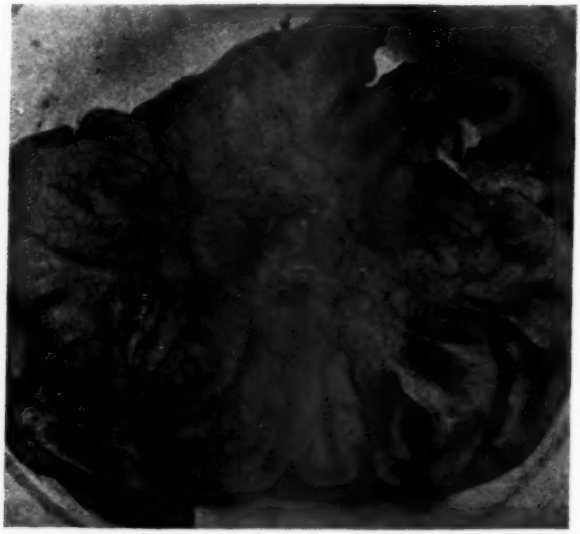

FIGURE I. Photograph of a specimen from partial gastrectomy showing a large ulcer of the lesser curvature near the pylorus. The patient, a chemist, aged thirty-three years, had been operated on for a perforation two years previously.

developed (see Figure I), and another twelve years after a perforation, when persistent pain and several attacks of melena led to the discovery of a chronic eroding posterior duodenal ulcer.

In America and Russia, during recent years, and because of this number of repaired perforations which progress, patients with early perforation are becoming treated more often by partial gastrectomy, with a view to dealing with the surgical emergency and relieving the patient simultaneously of a future chronic ulcer (Strauss, Judine).

Hæmatemesis.

About 10% of all peptic ulcers bleed, and in about 90% of cases gastric hæmorrhage arises from an ulcerative lesion of the gastro-duodenal tract. The mortality of this complication of peptic ulcer appears to be considerably greater than was formerly thought. (Bulmer, Birmingham Hospital, 10%; Chieseman, Saint Thomas's Hospital, 25%; Aitken, the London Hospital, 11%.)

Cases of hæmatemesis from peptic ulcer may be said to fall into two pathological categories. In the first, commoner in younger patients, the bleeding comes from a congested and eroded duodenal mucous membrane,

with no actual demonstrable ulcer (see Figure II). In such cases surgical treatment is hardly indicated, as there is little to be done, and in fact expectant treatment, with transfusion when necessary, effects a cure in the majority of cases. In the second category we include the case in which bleeding occurs in a patient with a radiologically demonstrated ulcer crater, or in which repeated bleeding takes place in a patient undergoing properly controlled medical treatment.

In this category the question of immediate surgery to control the bleeding vessels, or expectant treatment until the patient's condition warrants later

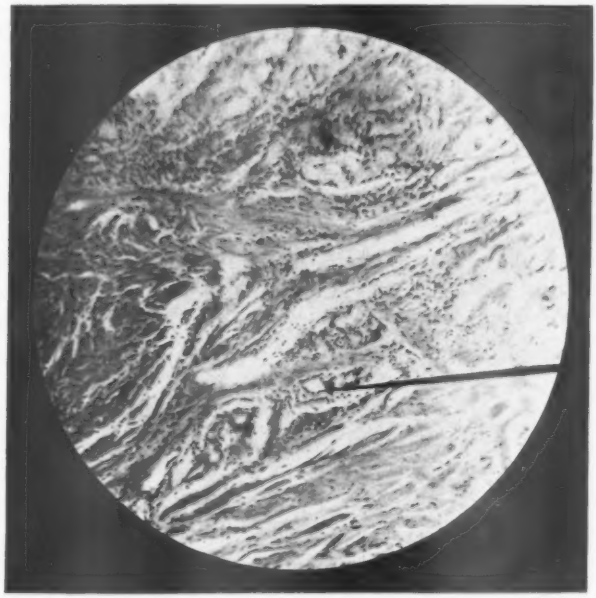

FIGURE II. Photomicrograph (×70) through the base of a chronic peptic ulcer to show blood vessels lying under the granulation tissue on the ulcer base.

surgery, requires decision. Finsterer and Gordon-Taylor are keen advocates of surgery within forty-eight hours, if operation is to be performed, and it may be said that in every case of any severity, as evidenced by a rapid pulse, a systolic blood pressure below 90 millimetres of mercury, air hunger and a blood count showing red cells below 3,000,000 per cubic millimetre and hæmoglobin value below 50%, immediate blood transfusion should be given whilst a decision is being made.

In this connexion it should be stated emphatically that a properly controlled and regulated continuous drip transfusion is not likely to raise the blood pressure to the extent of restarting or preventing cessation of bleeding. Recently in Melbourne hospitals the transfusion of uncitrated whole blood has been used with considerable success in these cases (Guest and Bradley).

If within one to twelve hours after or during transfusion the symptoms of shock do not show improvement, it is certain that the bleeding takes place from a large vessel which has been eroded (Graham) and operation should be immediately performed if life is to be saved. In such cases direct attack on the bleeding point—usually a posterior duodenal ulcer—combined

with some form of partial gastrectomy is the only operation feasible. In the average case, however, complete rest, under sedation, transfusion and "building-up" treatment, will tide the patient through the crisis and permit later radical surgery under better conditions.

Needless to say, the pre-operation building-up in such cases is most important. In this the Meulengracht diet is particularly valuable and should be started at an early date.

It is an axiom that surgical intervention should be carried out when at all possible in patients over forty-five years of age suffering from one or more

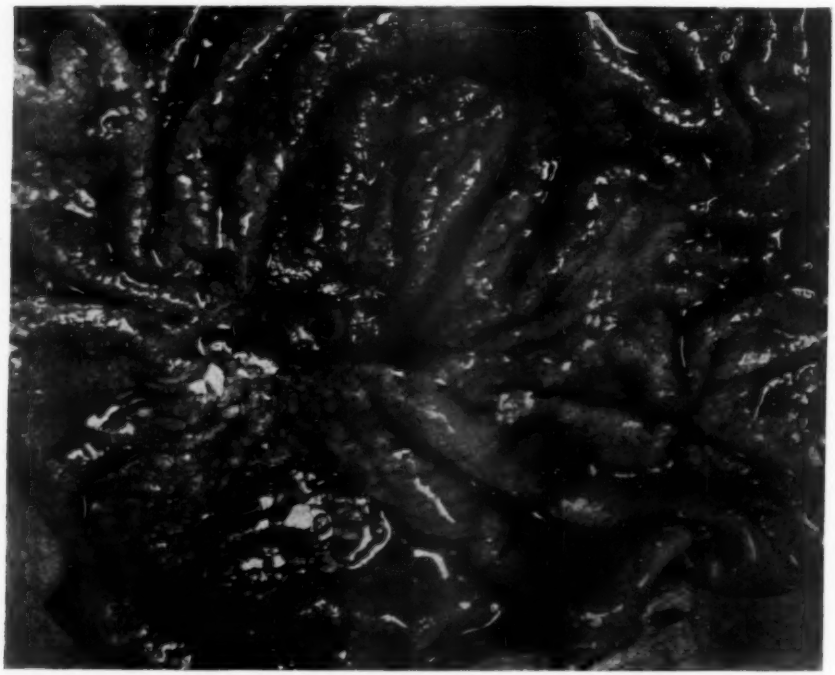

FIGURE III. Photograph of a specimen from partial gastrectomy, showing an eroded artery on the surface of the pancreas which formed the base of a chronic gastric ulcer involving the lesser curvature and posterior wall near the pylorus. The patient, a farmer, aged fifty-six years, had a ten years' history of ulcer with several periods of medical treatment in hospital. One severe "mass" hæmorrhage (hæmatemesis and melena) five days before his admission to hospital was followed by several small hæmorrhages.

attacks of hæmatemesis, who show X-ray evidence of chronic gastric or duodenal ulcer.

In the series of cases under review five patients (four male and one female) were admitted to hospital either during or immediately following a severe hæmatemesis. In no case was immediate surgical intervention necessary. Operation was carried out after blood transfusion and general building-up had rendered the patient a satisfactory surgical risk.

The treatment and pathological findings were briefly as follows: one (female), gastro-enterostomy with infolding of a small anterior duodenal ulcer; two (males), partial gastrectomy with "pinching out" or exteriorization of posterior duodenal ulcers eroding the pancreas and subsequent obliteration

of the ulcer crater *in situ*; two (males), partial gastrectomy with excision of pyloric ulcers (see Figure III). All five patients have made a good recovery and are back at work and domestic duties.

RELATIVE INDICATIONS FOR SURGICAL TREATMENT.

Having considered the absolute indications for surgical treatment in peptic ulceration, it is necessary to consider the relative indications.

Failure of Medical Treatment.

The major relative indication for surgery is the failure of medical treatment of peptic ulcer to give relief.

At what stage can we say that medical treatment has failed? Apart from the two complications just considered, there is no doubt that surgery today is employed in far fewer cases of gastric and duodenal ulcer than formerly, and is in fact reserved for the treatment of complications.

That operations for such complications are fewer than they used to be, is a tribute to the success of modern medical treatment. Ryle considers that no patient with peptic ulcer should be subjected to surgery without a five years' history of symptoms. Hour-glass stomach and pyloric obstruction have been mentioned as complications requiring surgical relief. They represent the effects of cicatrization around an ulcer. When a lesser curve or pyloric ulcer has eroded the pancreas, gastric motility is of necessity impaired, and it is difficult to see how any medical treatment will restore that motility.

The typically intermittent history of the ulcer patient attending the out-patient department suggests that temporary freedom from symptoms does not in many cases mean actual healing of an ulcer, but merely covering of the base with adherent slough, and a temporary reduction in gastric acidity—possibly from happier psychological reactions. Davies, in his Bradshaw Lecture of 1936, lays great emphasis on the importance of emotional factors, pointing out that recrudescence in ulcer symptoms is frequently associated with mental disturbance. He notes that experiment has shown that there is a centre high up in the nervous system which, when stimulated, produces profound disturbance both of motility and secretion in the stomach—a centre which is influenced by higher levels. Uncertainty of employment and a sense of social insecurity are all factors which influence failure of medical treatment in peptic ulceration. Furthermore, such adverse economic conditions render patients unable to carry out adequate medical and dietetic regimes, so that surgical intervention becomes necessary for the rehabilitation of the patient. It is in this category that a large proportion of operations for the relief of peptic ulcer are performed.

The Danger of Malignant Change.

We have also to remember the danger of malignancy in 10% of gastric ulcers which fail to heal under medical treatment and are shown radiologically to have a definite crater. These form an important surgical responsibility.

THE OPERATIONS BEST SUITED TO THE CONDITION.

Having considered the absolute and relative indications for surgery, we must now consider the operations best suited to the morbid condition present. In such cases two surgical operations have stood the test of time, namely, gastro-enterostomy and partial gastrectomy, and it is necessary to consider the special indications for each operation.

Gastro-Enterostomy.

Although of late years much criticized, there is no doubt that gastro-enterostomy still serves a very useful purpose in the treatment of peptic ulcer, provided the cases in which it is performed are carefully chosen. To quote Wilkie:

> Had gastro-enterostomy been restricted to its primary field of relieving pyloric obstruction, it would have received little but praise. It was, however, the very success of the early cases of gastro-enterostomy for pyloric stenosis that led to its abuse. Its employment as a short cut to cure any irritable ulcer, as a "hit at random" in cases with no ulcer, but with similar symptoms, as a drainage operation in cases of visceroptosis and of atonic stomach, led to an accumulation of surgical failures, bitter complainers, the driftwood of an uncontrolled spring tide of surgery.

However meticulously the operative technique is carried out, the ever-present bugbear of gastro-enterostomy is anastomotic ulcer. The incidence of this late complication varies considerably. In a survey of large numbers of cases operated on in British hospitals, Garnett Wright estimated the incidence of anastomotic ulcer as being 8·63% after gastro-enterostomy for duodenal ulcer and 4·48% when performed for gastric ulcer. Anastomotic ulcers may appear within a few months or after twenty years, and there is no doubt that persisting high gastric acidity is the major cause. In late occurring cases there is generally evidence that the patient has abandoned his ulcer regime and diet. Hinton and Church quote the incidence of this complication as being 16·4% in America, but the rate quoted by Continental surgeons is much higher, rising to 25% to 30%. This extraordinary divergence from British and American figures has been commented upon by Devine, who points out that in British clinics the operation has been carried out for small ulcers with low acidity. In such cases cure would probably be effected by modern medical treatment. On the other hand, a marked type of ulcerative gastritis of the pyloric antrum appears to be a common cause of dyspeptic symptoms in Germany (Walters) and the performance of gastro-enterostomy for this would certainly result in a high incidence of anastomotic ulcer. In any case the incidence of this complication has led many surgeons to abandon the operation in favour of more radical measures.

The operation should never be performed in young dyspeptic patients, generally subjects of duodenitis, or in early duodenal ulcer with high gastric acidity. We may say, however, that today gastro-enterostomy has a broad sphere of utility in all benign obstructions of the pylorus due to extensive adhesions, scar contracture from ulcer, and stenosis following operations for perforation.

The following statement shows the number of local hospital patients treated by this operation, together with the conditions for which it was selected.

Gastro-enterostomy was performed in 14 cases.

Male patients, nine.
Female patients, five.
Average age, forty-nine years.

Pathological condition—duodenal and pyloric adhesions:

(*a*) From old ulcer scarring, causing varying degrees of pyloric obstruction, nine cases.

(*b*) Small chronic ulcers on anterior duodenal wall, three cases.

(*c*) Pyloric obstruction *plus* cholelithiasis, one case.

(*d*) Chronic eroding pyloric ulcer, one case.

(In case (*c*) the patient died; wound disruption occurred on the sixth day following coughing from post-anæsthetic pneumonia. The wound was resutured.)

Mortality rate, 7%.

Actually the usual mortality rate of this operation is about 1%. These patients have been followed up in the out-patient department, and with the exception of the patient in group (*d*), whose condition was such that partial gastrectomy, the operation indicated, was impracticable, have all put on weight and feel well. They are all back at work. The patient in group (*d*), a woman, aged forty-one years, has occasional attacks of pain, but has gained eight pounds in weight. The technique employed in this operation has in each case been that of the classical posterior "no-loop" anastomosis through the middle colic arterial arcade of the transverse mesocolon.

In general, the immediate results of gastro-enterostomy in cases of duodenal ulcer are good, but for the good result to be maintained there must be a permanent reduction in gastric acidity.

The method of combining artificial pyloric occlusion with gastro-enterostomy in cases of duodenal ulcer, with a view to side-tracking completely the acid chyme, was first carried out in 1907 by Brewer, who occluded the pylorus by surrounding it with an aluminium band. Later, W. J. Mayo employed the Kelling-Mayo silk suture placed so as to infold the pyloric tissue without causing the trauma of tight constriction. Von Haberer divided the pylorus, suturing up the gastric and duodenal ends. These procedures, however, have not stood the test of time owing to the subsequent high incidence of anastomotic ulcer, and they are seldom used today. Direct attack on the ulcer, in combination with gastro-enterostomy, was first carried out by Balfour, who performed the local "wedge excision" of lesser curve ulcers with gastro-enterostomy, and the immediate results were satisfactory. The procedure, however, entails some deformity of the lesser curvature and interference with its function, and although still used in some cases of small ulcer situated high up on the lesser curvature, it has been largely abandoned in favour of partial gastrectomy. Local experience of the late complications of gastro-enterostomy during the period under review has been as follows.

Two patients with inoperable carcinoma of the pylorus were admitted to hospital. In both cases gastro-enterostomy for chronic pyloric ulcer had been performed, four and two years before respectively.

In one case of severe hæmatemesis, occurring in a patient who had had gastro-enterostomy performed seven years previously, an exploration was carried out for a suspected anastomotic ulcer. None was found, but the original duodenal ulcer was still present and the cause of the trouble.

A patient suffering from persistent vomiting with severe dehydration and alkalosis was admitted to hospital. His symptoms had commenced five years after a gastro-enterostomy, combined with pyloric ligature by silkworm gut. Exploration revealed stenosis of the opening of the efferent loop of the stoma with gross dilatation of the stomach and afferent loop. Entero-anastomosis between the loops was carried out, but the patient died from pneumonia five days later.

One patient with a large gastro-jejunal anastomotic ulcer, the second to occur in the same case, was admitted to hospital. Originally gastro-enterostomy with silkworm gut ligature of the pylorus had been performed for duodenal ulcer eight years previously. A gastro-jejuno-colic fistula had resulted. This had been resected by another surgeon three years later, and an anterior gastro-enterostomy substituted, the pyloric ligature being removed. At operation an anastomotic ulcer adherent to the left cupola of the diaphragm was found. It was detached, resected and the normal continuity of stomach and jejunum restored. The patient made a good recovery, and now is in good health and has gained two stone in weight.

I mention these surgical accidents, not in a spirit of criticism, for every surgeon has his failures, but to show how important it is to select not only the proper operation suited to the pathological changes of the case, but also to employ that technique which experience has shown to produce the best results.

Partial Gastrectomy.

Partial gastrectomy was first performed as a pylorectomy for a case of carcinoma of the pylorus by Pean in 1879, and since then has undergone considerable modification. Its development is essentially associated with Billroth, of Vienna. In 1887 he performed pylorectomy, joining up the stomach to the first part of the duodenum. This method was known as the Billroth I operation, and although it has limitations, it is still used in some clinics in the treatment of pyloric ulcer (Horsley).

One limitation of the operation is a tendency to stenosis at the junction of stomach with duodenum, and if there is local fibrosis from the infiltration of a chronic pyloric ulcer, it is very difficult to perform. Such

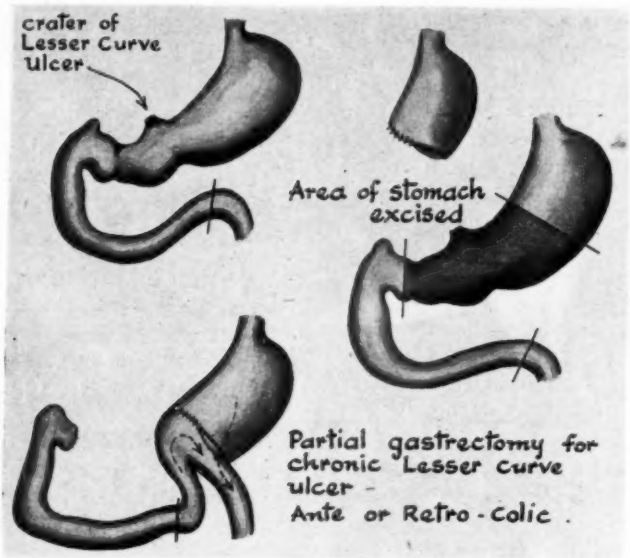

FIGURE IV.

difficulties led to the introduction of a modification—the ends of the stomach and duodenum were closed, and continuity of the gastro-intestinal tract was maintained by performing a posterior gastro-enterostomy. This operation is known as the Billroth II technique. Because of the liability of the anastomosis and jejunal loop to the same complications as gastro-enterostomy, Pólya modified the operation by anastomosing the entire cut end of the remaining stomach into the proximal jejunum, the so-called "end-in-side" technique. This procedure was known as the Pólya Billroth II operation and was performed either by the ante-colic or retro-colic route. Subject to minor modifications, it is the standard operation used today.

The unsatisfactory late results of gastro-enterostomy for peptic ulcer led surgeons to use for its relief operations designed originally for carcinoma of the stomach.

Partial gastrectomy has given particularly good results in the following types of cases:

1. Chronic duodenal ulcer. In such cases the ulcer may or may not be resected, depending on local difficulties, but a sufficient amount of stomach

must be removed to cause a permanent reduction of acidity. This will usually involve the greater (pyloric two-thirds) part of the lesser curvature with the corresponding portion of the body of the stomach and greater curvature (see Figure IV). If, owing to local technical difficulties, the ulcer is left in the

FIGURE V. Photograph of a specimen from partial gastrectomy showing a chronic prepyloric ulcer with a deep crater eroding the pancreas. The patient, a labourer, aged thirty-eight years, gave a two and a half years' history of epigastric pain, which, although periodic and related to meals at first, later became severe and persistent. One year before operation he had had six weeks' medical treatment in hospital.

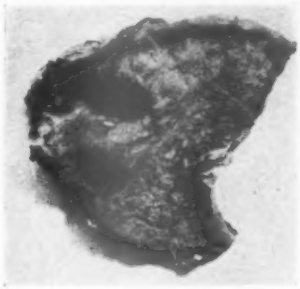

FIGURE VI. Photograph of a specimen from partial gastrectomy, showing a very large chronic ulcer of the lesser curvature at the pylorus, the base being adherent to the under surface of the left lobe of the liver. The patient, a barmaid, aged fifty years, gave a history of severe pain and vomiting related to meals for only six months, but stated she had been "subject to indigestion" for many years. Clinically an epigastric mass was palpable and malignant disease was suspected. Section, however, showed chronic ulcer, with no malignant change.

FIGURE VII.

FIGURE VIII.

Figures VII and VIII are photographs of two specimens from partial gastrectomies performed for chronic "high" lesser curve ulcers in male patients aged forty-nine and fifty-two years respectively. Histories were of two and a half years' and five years' duration, pain in each case being the predominating feature, relieved if the patient "could make himself sick". There were no symptoms of pyloric obstruction. X-ray examination revealed characteristic ulcer craters in each case. Occupations were: (*a*) agricultural implement salesman, (*b*) night watchman. (The pylorus is the border farthest from the crater in each photo.)

duodenal or pyloric stump, as in the Finsterer exclusion operation, the mucosa of the pyloric antrum should be dissected out, as experience has shown that its retention may give rise to some internal secretion influencing the acidity in the remaining stomach. Hinton has recently pointed out that such penetrating duodenal ulcers are more easily approached by dividing the stomach first, and approaching the ulcer crater from the body of the pancreas, than by attempting to divide the first part of the duodenum and work towards the stomach.

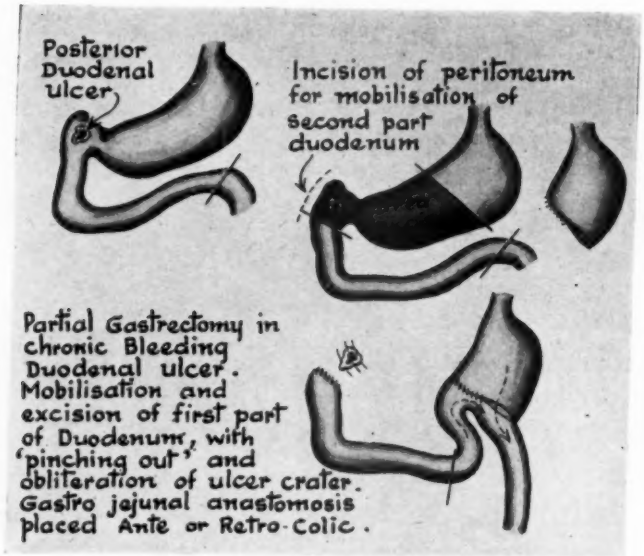
Posterior Duodenal ulcer
Incision of peritoneum for mobilisation of second part duodenum
Partial Gastrectomy in chronic Bleeding Duodenal ulcer. Mobilisation and excision of first part of Duodenum, with 'pinching out' and obliteration of ulcer crater. Gastro jejunal anastomosis placed Ante or Retro-Colic.

FIGURE IX.

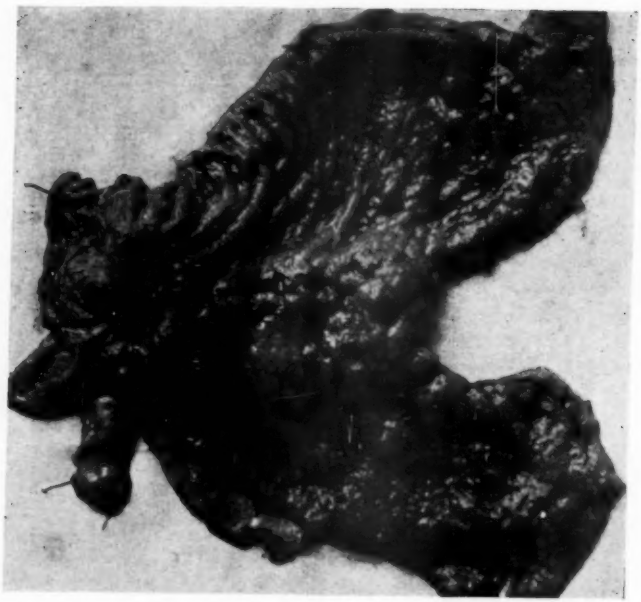

FIGURE X. Photograph showing multiple peptic ulcers. One large deep ulcer is situated at the pylorus, and base penetrating the pancreas, whilst several small punctuate ulcers involve the *Magenstrasse*. Partial gastrectomy specimen (1937) from a Chinese canal boatman, aged fifty-four years, who complained of symptoms of pyloric obstruction for only six months. Alcohol and tobacco "+ + +". Last observed in 1938, when he had gained twelve pounds and felt well.

2. Chronic pyloric ulcer, particularly if associated with hæmorrhage (see Figures V and VI). In such cases gastro-enterostomy has proved unsatisfactory, and partial gastrectomy gives excellent results.

3. Chronic gastric ulcer involving the lesser curvature, or *Magenstrasse*, particularly of the "saddle" variety (see Figures VII and VIII). These cases respond well to partial gastrectomy (see Figure IX).

4. In cases of multiple ulcers or hour-glass stomach. In these conditions partial gastrectomy should always be performed (see Figures X and XI).

The tendency of 10% of all gastric ulcers to become malignant is a further argument for advising radical surgery in groups 2, 3 and 4.

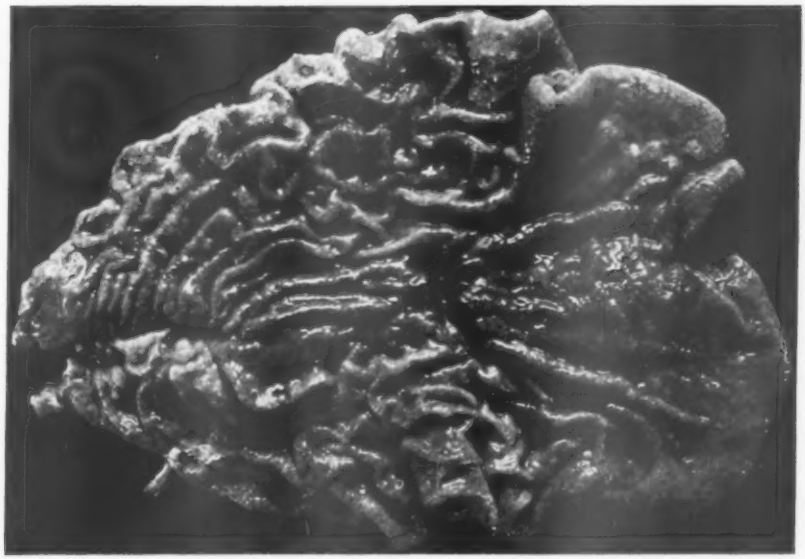

FIGURE XI. Photograph of a specimen, removed by partial gastrectomy in 1937, showing a deep saddle ulcer about the middle of the lesser curvature, with a smaller ulcer higher up. The patient, a Chinese male telephone operator, aged thirty years, had suffered from indigestion for six years. He had had two attacks of severe hæmatemesis in 1933 and 1936. When last seen in 1940 he was well and had put on one stone in weight.

The following statement shows the pathological conditions present in our local cases in which gastrectomy was performed.

Gastrectomy was performed in 24 cases.
- Male patients, 17.
- Female patients, 7.
- Average age, fifty years (extremes, thirty-three and sixty-eight years).

Pathological condition—
- Duodenal ulcer—5 cases (all patients had had serious bleeding and two ulcers had previously perforated). All ulcers were situated on the posterior wall of the front part of the duodenum, eroding the pancreas.
- Gastric ulcer—19 cases (five patients had had severe hæmatemesis, three of them twice). The ulcers were as follows: hour-glass stomach, 1 case; lesser curvature, 11 cases; juxta-pyloric, 5 cases; posterior wall, 2 cases.
- One death occurred; it was caused by kinking of the efferent anastomotic loop one week after operation.

In these cases the operative mortality was 4·1%. In the majority of cases the Hoffmeister technique of partially closing the cut stomach, so that the opening left for anastomosis to the jejunum is reduced to about two and a

half inches long, has been followed. The upper sutured margin of the stomach is reinforced by stitching to the jejunal loop, proximal to the stoma, the so-called Finsterer spur being formed. In this way, with the afferent jejunal loop attached to the lesser curvature end, the spur preventing any duodenal reflux of gastric contents and the efferent loop falling without kinking from the greater curvature end, there is no possibility of obstruction of the anastomosis.

The anastomosis may be placed behind the transverse colon through the arterial arch in the mesocolon, as in posterior gastro-enterostomy or in front of the transverse colon when the jejunal loop must be longer. In the small percentage of patients subjected to gastrectomy who do develop anastomotic ulcers (2%), usually because too little stomach has been resected with little reduction in acidity, an anterior anastomosis is easier of acess to the surgeon.

FIGURE XII. Photograph of specimen removed in 1935 by partial gastrectomy from a Russian man aged thirty-eight years. A large pyloric ulcer with marked induration is present on the posterior wall of the antrum. A smaller circular ulcer near the upper border of the pylorus (marked with an arrow) adjoins the larger crater, and had involved the peritoneal coat of the stomach. This patient was well and free from symptoms when last seen in 1939.

Some important technical points are:

1. Especial care must be taken to ensure that the duodenal stump is securely closed. This procedure is easy in cases of resection for gastric ulcer, but may be difficult when a chronic eroding posterior duodenal ulcer is present. In such cases the method of Finsterer may be followed, where the ulcer is left untouched in a cul-de-sac of pylorus; when protected from constant irritation by the acid chyme, it invariably heals. If this is done, any pyloric mucous membrane must be excised, as mentioned previously. If, however, there has been any severe bleeding from the ulcer, the crater should always receive direct attention. Full excision may be technically a very difficult and dangerous proceeding, not only because of local vascularity but because of the proximity of the common bile duct. It may, however, be exteriorized from the duodenum, which is well mobilized by incising the avascular peritoneum on its outer side, and then opened. The mucous membrane is then dissected free from the ulcer crater, and the duodenum closed securely below it, as carried out by Graham. The ulcer crater is then swabbed with antiseptic, obliterated by mattress sutures and covered with omentum. The duodenal stump itself is best closed by a continuous through-and-through "00" catgut suture, followed by a sero-muscular invaginating suture. This suture line is then buried by invaginating mattress sutures of fine (number 27) cotton, and covered by omentum.

2. When any ulcer penetrating the pancreas has been excised, a raw oozing surface results, and after the bleeding points have been carefully secured (they are best picked up by Halsted mosquito forceps), an attempt should be made to peritonealize it by drawing the surrounding peritoneum on the posterior wall of the lesser sac together, to cover it, with fine catgut sutures. The great omentum is then turned up to cover over the whole area.

3. Before the abdomen is closed the gastro-jejunal anastomosis should be carefully inspected to see that it lies in good position *vis-à-vis* the transverse

colon and that neither the afferent or efferent loops are kinked in any way.

4. It is always wise to place a glove drain down to the duodenal stump and to the "ulcer area" on the pancreas, bringing these out through a separate stab incision to the side of the laparotomy incision. They remain in three to four days. Accidents have occurred through "back pressure" on the duodenal stump suture line from stomach contents passing retrogradely, although this is practically unknown with the Finsterer spur operation. A duodenal fistula can result from leakage and is very serious if unrecognized. A small leakage of pancreatic juice from the ulcer bed in an eroded pancreas is not infrequent and with proper drainage does no harm.

On two occasions I have had leakage from the stomach with high resections for lesser curve ulcers and on one occasion from the pancreas. In all these cases suction drainage by catheter in the wound cleared up the discharge with complete healing of the fistula in a week to ten days.

5. On the patient's return to the ward from the operating theatre a Ryle's duodenal tube is passed and connected to siphon drainage bottles. Suction drainage is maintained for several days. It gives immediate indication of any bleeding into the stomach from the suture line and relieves any intragastric tension by gas or fluids, enabling the patient to start drinks by the mouth within twelve hours.

In every operation for peptic ulcer in which it is decided to perform gastrectomy, an intravenous saline solution and glucose injection is started routinely in the operating theatre. A blood transfusion is given immediately the patient returns to the ward and afterwards the intravenous saline solution and glucose injection is continued for several days, depending on the patient's condition. A careful fluid balance chart is maintained throughout. Both intravenous and suction drainage are discontinued when the bowels act by enema.

Recent work in America has shown that most patients suffering from peptic ulcer for any length of time—and these are particularly the type subjected to this operation—suffer from a marked degree of hypoproteinæmia. It has been shown that if a high nitrogenous dietary is given in the post-operative period convalescence is greatly expedited (Tui, Wright, Mulholland *et alii*). To date a solution of amino acid compound has been utilized; it is generally given by the Ryle's tube because of a rather unpleasant taste, but further developments may be expected in this sphere.

Follow-Up.—The patients reported on have all been systematically followed up. The men have returned to work in times varying from three to seven months after the operation. There has been a marked tendency to gain in weight, the greatest gain recorded being three stone in twelve months.

A degree of secondary anæmia is usually found to be present at the time of discharge from hospital, usually manifesting itself clinically as fatigue developing after slight exertion. It is necessary to keep these patients on iron for several months, and a course of liver extract injections is very helpful.

Collected results show that in about 90% of cases complete relief of the symptoms of peptic ulceration is obtained by this operation, the late results being much superior to those of gastro-enterostomy.

Summary.

I have reviewed the two principal operations in use today for the treatment of peptic ulceration. One may sum up by saying that gastro-enterostomy has a useful but somewhat limited sphere. Its operative mortality rate is low and its immediate results are good. Unless performed in cases of low gastric

acidity, its percentage of late complications is high. The operative mortality rate of partial gastrectomy is of necessity higher, but its late results are very good. It is particularly indicated in cases of duodenal ulcer with high acidity, and in chronic gastric ulcers of the pylorus or lesser curvature. In so far as duodenal ulcer is concerned, the removal of a large portion of an apparently healthy stomach to reduce acidity is admittedly unphysiological. Until, however, the ætiology of causative factors of hyperchlorhydria is fully known, the periods of economic incapacity caused to sufferers from peptic ulceration demand practical results, and although gastrectomy is the more severe operation, the 10% prospect that anastomotic ulcer may follow gastro-enterostomy requires serious consideration.

All will agree that prevention is better than cure when surgical operation carries with it a mortality rate, and that the study of peptic ulcer should be concerned with its ætiological factors. Until these causes are capable of correction, we must be selective in our treatment.

In discussing the surgical treatment for any case, all sides of the question must be considered. If the best results are to be obtained we must preserve an open mind, and the decision as to the type of operation to be performed must be made on the laparotomy findings. We must, as Cutler points out, first select the patient for operation and then the operation for the patient. Only in this way will the morbidity and surgical mortality rate for peptic ulcer be lessened.

CANCER OF THE STOMACH.

Because of the definite relationship of chronic gastric ulcer to carcinoma of the stomach, which has been referred to in this paper, I feel it opportune to quote figures from the Statistician General, showing the local incidence of this disease.

During the year 1940 (the last year for which Federal statistics are available), whilst 483 people in Australia died from direct complications of peptic ulcer of the stomach or duodenum, 1,816 died from cancer of the stomach. In the State of Tasmania during the three-year period under review, deaths from peptic ulcer totalled only 39, whereas those from cancer of the stomach totalled 208. Of the 208 persons 66·8% were sixty-five years of age and over. The general position today in regard to the treatment of cancer of the stomach is indeed gloomy.

Payne, in his Hunterian lecture of 1940, reviewed 506 cases admitted to London hospitals and found that partial gastrectomy was possible only in 54 cases—in other words, in only one in ten were the accepted criteria of operability present. Of the 54 patients 18 died following operation, giving an operative mortality of 33·3%. The mortality from exploratory laparotomy alone came to 21%. If these figures are reduced to 100 patients with carcinoma of the stomach admitted to hospital, in only ten cases could abdominal exploration be followed by removal of the growth. Of the ten patients only seven survived the operation.

A similar mortality rate was published from the Saint Thomas's Hospital 1935 series, and a 34% mortality rate is given by Lahey in the same year. Our local figures are even more depressing.

During the period under review 53 patients with cancer of the stomach were admitted to the Royal Hobart Hospital, of whom 36 were males and 17 females. The average age was fifty-five years, with extremes of twenty-four and sixty-seven. Of these, 25 were considered suitable for exploration. In six cases exploration only was possible and five of the patients died. In 19 cases the growth was removed by the operation of subtotal gastrectomy, and of the 19 patients eight died in hospital, giving a mortality rate of 42%.

The survival follow-up is not very bright. One patient is alive eighteen months after gastrectomy, but metastases have appeared. Another is alive one year and others nine and eight and seven months respectively with no signs of recurrence. The others have died from early metastases.

It is not within the scope of this paper to discuss at length the clinical symptoms of carcinoma of the stomach. Surgery offers the only possible cure, and by the figures quoted the prognosis is poor. Only in the early case can cure be hoped for, and it behoves us therefore to advocate exploration in every chronic ulcer case in the cancer age group which is resistant to medical

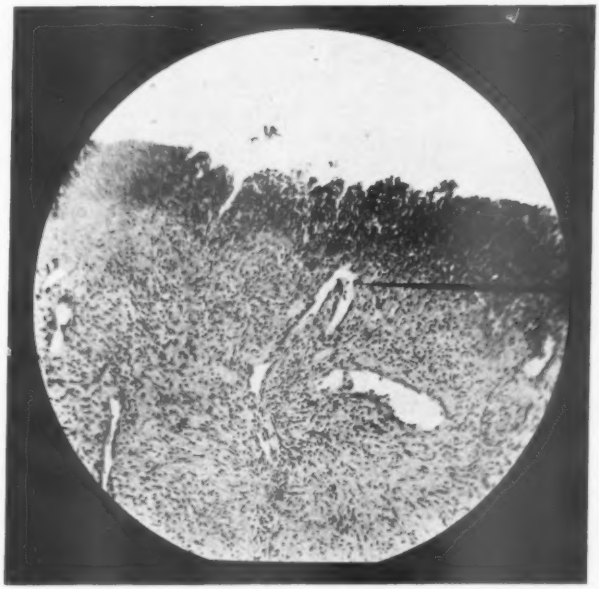

FIGURE XIII. Photomicrograph (×70) taken through the base of a chronic peptic ulcer of the lesser curvature near the edge to show acini invading the smooth muscle coat of the stomach—an indication of early malignancy.

treatment and in all cases in which sudden unexplained dyspepsia develops after the fourth decade, particularly if persistent, despite indefinite radiological evidence of neoplasm.

Carcinoma is most commonly met with in the stomach as the sessile or ulcerating type, which unfortunately is symptomless in its early stages, unless developing from ulcer, but infiltrates widely and gives rise to early metastases. (See Figures XIII, XIV, XV and XVI.) It is commonly found near the pylorus and lesser curvature, and this again lends weight to the argument in favour of gastrectomy for chronic ulcers in this area. The high operation mortality rate requires consideration.

Saltzstein and Sandweiss found that 60 of post-operative deaths in carcinoma of the stomach were due to peritonitis and pulmonary infections, and in our local cases these conditions appeared about equally as causes of death. Payne points out, however, that many of the deaths in the post-operative period are also attributable to antecedent toxæmia, nutritional disturbance and dehydration and alkalosis—factors which are capable of correction to some extent.

In all cases, therefore, careful pre-operative preparation is indicated. Gastric lavage and suction drainage will reduce a great deal of the gastritis surrounding an ulcerating growth and reduce infectivity of the stomach contents. Avitaminosis is always present in some degree, and vitamins, especially vitamin *C*, should be given liberally. Anæmia is corrected by transfusion of blood, and the pre-operative hæmoglobin value should be at least 70%. The worst feature in this disease, however, is that most cases are in the strict sense inoperable by the time the diagnosis is made.

FIGURE XIV. Photograph showing malignant change in a chronic gastric ulcer. Specimen of portion of stomach and first part of duodenum removed by partial gastrectomy. A large ulcer crater is present at the posterior wall of the pylorus, the base eroding the pancreas. The edge of the ulcer on the duodenal side is smooth, whilst that on the stomach is hard and everted and has become carcinomatous. The patient was a Chinese woman, aged forty-nine years, with a five-year history of indigestion, definite pyloric obstruction being present for three months prior to operation.

Enlarged lymph glands will always be found in the following sites in any case of chronic gastric ulcer, that is, the pyloric and the superior and inferior gastric glands lying along either curvature. Glands round the cœliac axis will also show enlargement. Since these enlargements may be due to inflammation in a case of carcinoma, or when induration round an ulcer suggests that transition to malignancy may have occurred, as many glands as possible should be removed with the portion of stomach resected, as well as most of the omentum, which is easily freed from its attachment to the transverse colon.

In carcinoma cases a gastrectomy should be at least subtotal, involving most of the lesser curvature and the first part of the duodenum. It should be noted that during recent years a number of successful total gastrectomies have been reported by Lahey and others.

In cases which appear hopelessly inoperable by reason of gland involvement or metastases, a partial gastrectomy removal of the growth will give the patient a lot of relief and is an excellent palliative measure. (See Figures XVII and XVIII.)

FIGURE XV. Photograph of a specimen from "palliative" subtotal gastrectomy for carcinoma of the stomach in a woman aged fifty-seven years. A large ulcer with typical everted edge has replaced the normal mucosa of the whole pyloric antrum. The growth was adherent to the liver, but no visible metastases were present. The patient was alive and comfortable, and performing her housework ten months after the operation.

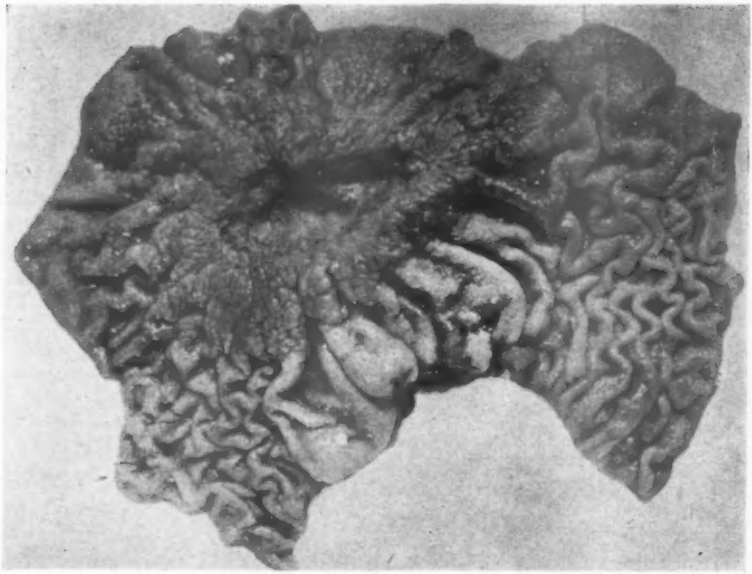

FIGURE XVI. Photograph showing a large ulcerating carcinoma of the lesser curvature of the stomach; specimen from a palliative subtotal gastrectomy. The base of the ulcer, which was adherent to the pancreas, shows "terracing", suggesting that the original condition was a chronic ulcer. The patient was a Chinese labourer, aged fifty-four years, complaining of attacks of pain and vomiting after food of six months' duration, but also a preceding vague history of dyspepsia. The patient survived operation and left hospital, but was not heard of subsequently.

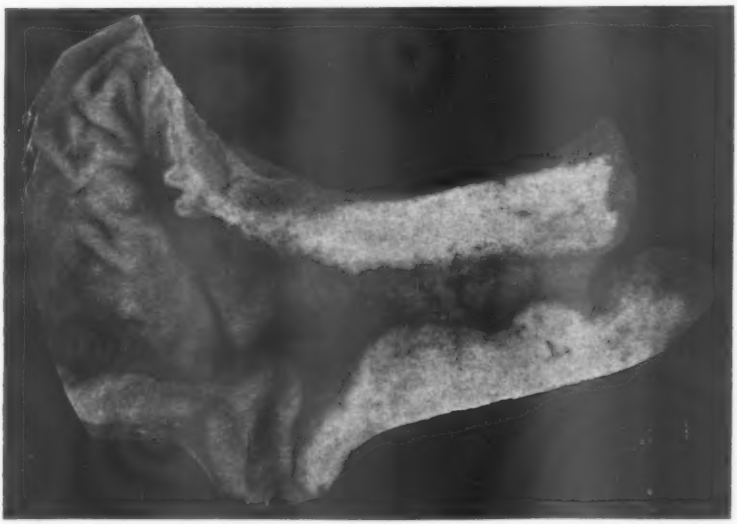

FIGURE XVII. Photograph of a specimen from subtotal gastrectomy for carcinoma of stomach of a woman aged fifty-one years. The specimen is of the typical "leather-bottle" type, but microscopic section shows this to be a colloid growth with the typical signet-ring type of cell liable to give rise to the so-called "Krukenberg" tumour of the pelvis. The patient lives a reasonably active domestic life in comfort eleven months after the operation.

SUMMARY.

1. The object of this paper has been to review briefly the present-day position regarding the incidence and treatment of peptic ulceration in the community.

2. The indications for surgical treatment are discussed generally, as are the indications for gastro-enterostomy and gastrectomy respectively in detail.

3. Local hospital statistics are given to show the mortality rate of surgical treatment, and the pathological findings which led to the selection of the operative procedure used, are described.

4. A brief review of local experience in the treatment of carcinoma of the stomach is given.

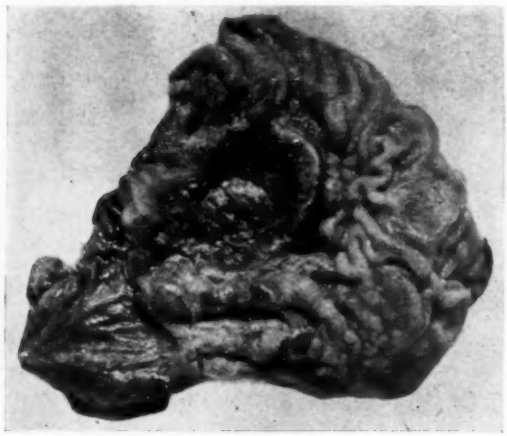

FIGURE XVIII. Photograph showing an ulcerating carcinoma of the lesser curvature of the stomach. Specimen from a case of palliative gastrectomy, performed in a Chinese, aged sixty years, with one year's history of epigastric pain. A palpable mass was present.

ACKNOWLEDGEMENTS.

I am greatly indebted to the superintendents of the Royal Melbourne and Saint Vincent's Hospitals for ulcer statistics, to Dr. Campbell Duncan for his photographs, and to Mr. Colbron Pearse for the diagrams.

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THE EARLY TREATMENT AND RESULTS OF PENETRATING WOUNDS OF THE CHEST: A FURTHER REPORT.[1]

By C. W. B. LITTLEJOHN,
Colonel, Australian Army Medical Corps.

THE appearance in various journals of articles dealing with penetrating wounds of the chest has stimulated me to fulfil a three-year-old promise. This promise was to publish the later results in a series of chest wounds reported in this journal in 1941.[1]

THE END-RESULTS IN ONE HUNDRED CASES.

The series of 100 cases was collected during the first six months of the siege of Tobruk. The patients received this early treatment at an Australian general hospital situated just outside the town itself. The conditions were practically those of forward area surgery, except that the staff and equipment were always adequate, and it was possible, and indeed often necessary, to retain patients for a considerable time.

Briefly, of the 100 patients, 21 died, seven of chest wounds and 14 of chest wounds complicated by multiple other wounds, abdominal wounds or spinal cord transection. Seventy-nine were evacuated to the base, and of these one died of transection of the cervical cord; 78 survived. Of the 78, five developed empyema, four as the result of infected hæmothorax and one following removal of a foreign body six weeks after the infliction of the wound. In this last case the pleura was uninfected at the time of operation.

Apart from suturing of sucking wounds, only three patients had early operation for the chest wound. Two were operated upon for removal of very large foreign bodies and one for severe pain due to friction of a foreign body on the pleura. These three patients survived.

The routine treatment was aspiration, commenced in the earlier months after forty-eight hours. As the bogy of renewed hæmorrhage faded, aspiration was commenced after twenty-four hours, and in cases of necessity even earlier. Aspiration was repeated whenever there were signs of reaccumulation of fluid, and every endeavour was made to keep the pleural cavity as dry as possible. Sulphonamides were given by mouth or parentally as a routine procedure.

DISCUSSION.

Four factors which may be of importance in accounting for the low incidence of empyema require consideration.

1. The low bacterial content of the dry desert soil. This factor has been scouted by some and supported by others. Bacteriological examination of fresh wounds in Tobruk gave results much the same as those usually quoted. *Staphylococcus albus* was present, with diphtheroids and clostridia, but few of the pathogenic cocci were found.

2. Scanty clothing worn by the men.

[1] Accepted for publication on November 22, 1944.

3. The type of wounding missile. Uncomplicated bullet wounds heal famously, but the great majority of these wounds were the result of shell, bomb, mortar, mine and other explosions.

4. The struggle to keep the pleural cavity dry. This is no new form of treatment; in France in 1918 it was coming into great prominence, with a consequent enormous improvement in results.

Such statements as "Aspiration may be carried out if there is respiratory or cardiac embarrassment", "The mere presence of a hæmothorax warrants neither operation nor aspiration",[2] and similar pronouncements are doing the gravest disservice to the wounded soldier. Reports indicate that the incidence of empyema in chest wounds in some theatres of war is in the neighbourhood of 30%,[3] and if advice such as is quoted above is to be accepted, this figure is not surprising.

To make the moral still more pointed, experience in New Guinea may be recorded. A careful surgeon in a forward team treated 13 patients by routine aspiration with one empyema. Under exactly similar conditions, a second team without the same appreciation of the value of this treatment, had more than three times this incidence of empyema.

If a hæmothorax is present, aspiration should be commenced, as a general rule, at twenty-four hours after the wounding, and repeated at intervals of twenty-four to forty-eight hours until the pleural cavity remains dry.

ACKNOWLEDGEMENTS.

My thanks are due to the Director-General of Medical Services, by whose permission this paper is published.

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Case Reports.

A GIANT CELL TUMOUR OF THE PATELLA.[1]

By J. Estcourt Hughes,
Surgeon Lieutenant-Commander, Royal Australian Naval Reserve.

J.N., aged twenty years, a carpenter by trade, presented himself on April 26, 1940, complaining of an injury to his right knee. The immediate injury was a blow across the knee-cap from a piece of timber with which he was working, but he stated that for two and a half years he had had "fluid on the knee" following a previous strain of the knee sustained whilst playing football. He was confined to bed for four weeks after this

X-ray photograph showing lateral view of patella.

injury, and said that he was treated by aspiration of the joint coupled with the application of "Iodex" and crêpe bandages. He stated that, whereas previously his knees had appeared identical, they had never been so since, and he further noticed that nine months previously his thigh muscles on the right side had begun to become thinner. Between the initial injury and that for which he now sought advice he had had one other spell from work when he slipped on some roof timbers and twisted the same knee. Up to the time of the latest injury walking gave him no trouble, but if he attempted to swim or to run, the joint felt weak. His health was otherwise satisfactory and his past history contained nothing relevant to the present condition.

[1] Accepted for publication on September 11, 1944.

Examination of the right knee joint showed that the swelling which the patient had regarded as due to a synovial effusion was, in fact, due to a generalized enlargement of the patella. The recent injury had left no signs, except that there was a small synovial effusion, which might or might not have been of recent origin, but probably was not. There was no evidence of any lesion of any other joint structure and the function of the joint was not impaired. At seven inches above the patella there was two inches of quadriceps wasting on the right side.

As the nature of the patellar swelling was not apparent, an X-ray examination was undertaken and Dr. B. S. Hanson reported:

"Practically the whole of the patella, with the exception of a small shell on its upper outer margin, is enlarged, and the normal bone replaced by a multilocular cystic condition involving the presence of numerous small septa and several larger ones. There is a fracture involving the anterior surface. The appearance indicates that the condition is not invasive. It is either (*a*) fibrocystic disease or (*b*) a giant cell tumour. The former appears more likely."

Operation to remove the patella was advised and was undertaken on May 1, 1940. A strip of *fascia lata*, removed by a fasciotome, was used to darn the gap left by the removal of the patella, care being taken to keep the knee partly flexed during the process so that the darning should not be made too tight and interfere with the recovery of full flexion. A simple multi-layer compression bandage was applied after operation and quadriceps exercises were commenced forthwith. It is interesting to note that during the immediate post-operative period the patient complained of some pain in the thigh from which the fascial strip had been removed, but scarcely at all of the knee. Healing occurred without interruption and in eight days the amount of synovial effusion present did not exceed that present before operation. In fourteen days he was allowed up and made a steady functional recovery. In six weeks the patient was seen and was free from complaints, and expressed himself as surprised how strong his knee felt, having believed in the indispensability of the knee-cap. Examination showed the joint to be in a satisfactory state and the quadriceps tone was good, with the amount of wasting much reduced.

The anterior surface of the removed patella showed bone of "eggshell" thinness, while the cartilaginous surface was yellow in colour and at one spot was almost perforated.

A microscopic examination of the tumour was carried out and the report was that it was a giant cell tumour.

The last report received of the patient was that he had returned to his work as a carpenter and had had no further trouble with his knee.

LOCULATED EMPYEMA: A COMPLICATION OF HÆMOTHORAX.[1]

By RUSSELL N. HOWARD,
Lieutenant-Colonel, Australian Army Medical Corps, Australian Imperial Force.

THE following three cases of loculated empyema are the only cases of this complication occurring in eighty-four penetrating lung injuries in Australian battle casualties from the Western Desert during the five-month period July to November, 1942.

In this series there were fifty cases of hæmothorax gross enough to be clinically appreciable, and in eleven of these empyema developed. That three of these eleven cases should have been of the loculated variety is noteworthy.

The cases recorded here have not been followed to their ultimate conclusion, but it is thought fit to present them at this stage, because they furnish object lessons of immediate importance.

Case I.

Private R.K., aged twenty-two years, on July 13, 1942, sustained a shrapnel wound of the right side of the chest. The missile entered close to the angle of the right scapula, traversed the chest wall, pleural cavity and lung and lodged in the *pectoralis major* muscle over the second right intercostal space (see Figure I). Immediate pain and dyspnœa were experienced; no hæmoptysis occurred at any time. The wound did not "suck", but surgical emphysema of the chest wall was later noted. The parietal wound healed rapidly with minimal treatment. Early X-ray examination showed the foreign body to be situated as described; it also revealed a large hæmopneumothorax; no rib fracture was apparent.

On July 20, at a British hospital, seventeen ounces of blood were removed from the right pleural sac. Bacteriological examination showed this to be sterile. On July 30 the patient was admitted to an Australian hospital and a further seventeen ounces of blood were aspirated (this was not sent for bacteriological examination). X-ray examination showed much fluid still present. On August 19 twenty-four ounces were drawn off and found to be infected with *Bacillus alkaligenes fæcalis*. On August 23 twelve ounces more were removed, with similar bacteriological findings. The blood was not macroscopically purulent, but had an unpleasant odour. X-ray examination revealed a considerable amount of fluid still present in the right pleural cavity in two main loculi. The patient had been running a remittent temperature rising to 103° F. in the evening and was now seriously ill. This febrile state had been uninfluenced by exhibition of sulphapyridine.

On August 27 an intercostal tube was placed in the eighth right intercostal space postero-laterally. Figure I shows the condition two days later (August 29)—that is, a well-drained main cavity with tube in place, a large undrained apical loculus and a small basal loculus apparently fluid-free. Continuous negative pressure drainage had been established and the pressure was maintained at −5 inches of mercury in the hope that the apical loculus would burst into the draining area. This loculus was needled and four ounces were drawn off (the bacteriological findings were as above). The temperature fell immediately to a lower level and gradually subsided to normal. X-ray examination on September 21 showed that the apical loculus had broken into the general cavity which was decreasing in size. Drainage from the empyema during this period had been free and admirably maintained by the intercostal tube.

On October 16, under local anæsthesia, the piece of shrapnel was removed from the right side of the chest wall. The patient was very well and ambulatory.

On December 12, 1942, he was transferred to a hospital ship. A small tube was still *in situ*, draining fairly freely. The cavity, situated postero-laterally and subapically, was now of such a size as to hold six ounces of fluid.

An X-ray photograph taken in March, 1943, in Australia, showed this cavity to be still persistent. Chest movement on this side was considerably restricted.

At the time of receipt of the chest wound some pieces of shrapnel entered the right thigh in its lower part. These were later removed, but the wound proved annoying in that it hindered pulmonary rehabilitation exercises.

Comment.—This was a case of extensive right hæmopneumothorax, the contents of which were sterile ten days after the wounding. Had it been emptied at this period it

[1] Accepted for publication on March 6, 1944.

FIGURE I.

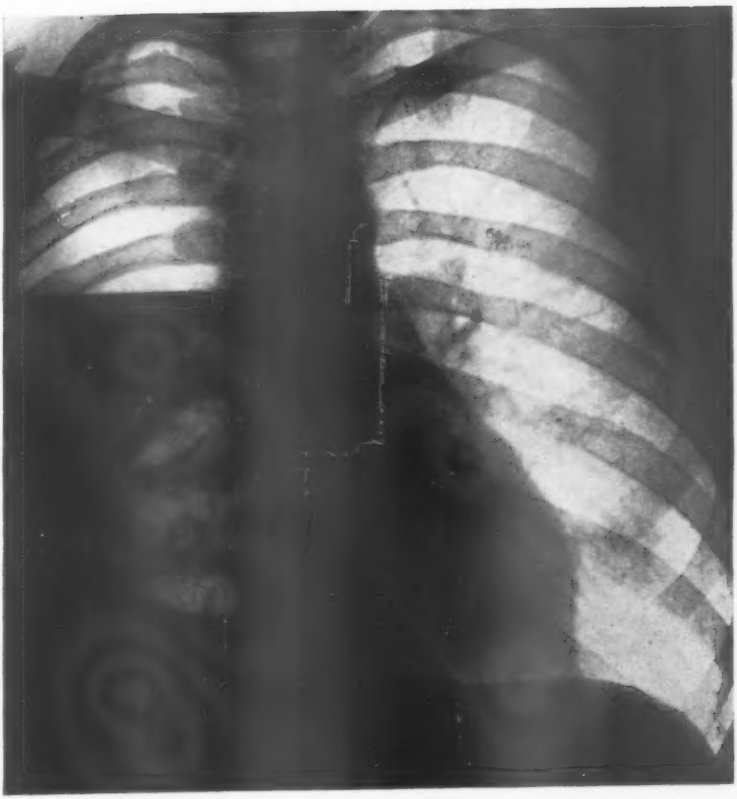

FIGURE II.

is probable that recovery would have been uneventful. Further aspiration was deferred for ten days. By this time infection would seem to have been established. Once tube drainage was effected, treatment proceeded along usual lines. Further operative measures to obliterate the empyema cavity may have to be taken.

Case II.

Private R.C.G., aged twenty-one years, on October 31, 1942, sustained a shrapnel wound of the chest. A small entry wound was present in the right axilla; there was

FIGURE III.

no exit wound. Pain in the chest, dyspnœa, slight cough and mild hæmoptysis occurred immediately. The wound did not "suck". The hæmoptysis ceased in twenty-four hours and the wound healed rapidly without special treatment.

He was admitted to an Australian lines of communication hospital on November 4, and X-ray examination showed that there was a considerable right hæmopneumothorax with a small foreign body situated against the right border of the mediastinum. On November 8 a "small amount" of blood was aspirated from the right pleural cavity. At some time during the next few days the patient coughed up a piece of shrapnel the size of a split pea.

On November 25 he was transferred to another Australian hospital. On November 27 and on December 1 a total of three ounces of blood was removed from the right pleural sac.

An X-ray photograph, taken on December 3, showed gross collapse of the right lung with three fluid levels in the right pleural cavity. Three ounces of blood were withdrawn; for the first time this was examined bacteriologically and was found to contain

Staphylococcus aureus. During this period the patient's general condition had been good and his temperature of the order of 99° F. in the evenings. Gross scoliosis with convexity to the left had developed, in considerable degree owing to the patient's completely uncooperative attitude. On December 14 X-ray examination showed no change. On December 23 a small amount of purulent blood was withdrawn which again yielded *Staphylococcus aureus*.

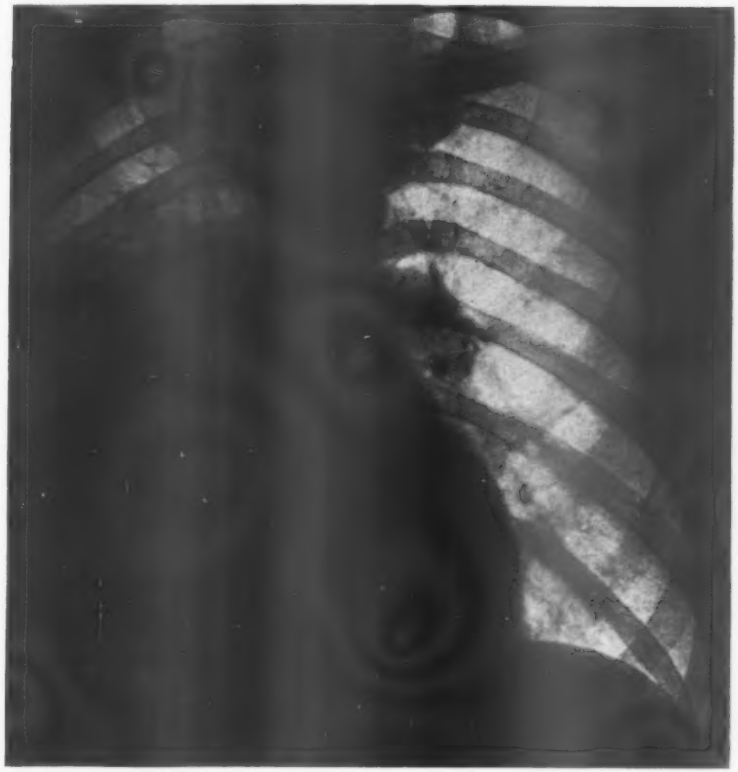

FIGURE IV.

On December 24, 1942, under "Pentothal Sodium" anæsthesia, an intercostal tube was inserted in the eighth right intercostal space postero-laterally. Owing to the narrowed rib interspaces (caused by scoliosis) drainage was inadequate; this is shown in Figures II and III, the X-ray photograph having been taken on January 5, 1943. (The tube has been removed; the piece of metal is a "marker".)

On January 6, under local anæsthesia, three inches of the eighth rib postero-laterally were resected and the empyema cavity was opened. Two distinct loculi were present—a smaller basal one and a larger apical one. The septum was broken down thoroughly and continuous negative pressure drainage was established, a Tudor Edwards tube being used.

On January 12, in order to facilitate the patient's repatriation, this tube was replaced with a slightly smaller one designed to drain into a dressing and he was transferred to a hospital ship on January 16. His general condition was excellent; scoliosis was still present.

Comment.—The delay in attempting to empty this hæmothorax was considerable (in the first twenty-five days only one rather abortive attempt at aspiration was made). This inadequate emptying is probably responsible for the development of infection. Further delay occurred in effecting adequate tube drainage. Very little change in the condition of the patient was noted to mark the development of infection.

Two other features are worthy of special note: first, the unusual occurrence of the coughing up of a foreign body introduced through a penetrating wound and, secondly, the rapid development of scoliosis. I first saw this man four and a half weeks after he had been wounded and the scoliosis was then almost unbelievably gross, despite determined efforts by a competent masseuse to counteract it. I believe that he actually enjoyed the comment and sympathy which it evoked from his fellows. It was only by dint of turning their sympathy into derision that he was made to attempt to correct it.

FIGURE V.

Case III.

Private R.B., aged thirty-two years, on October 31, 1942, sustained a shrapnel wound of the chest. The entry wound, situated in the right axilla, was very small and healed rapidly without special treatment. Immediate pain in the chest, dyspnœa, cough and slight hæmoptysis occurred; the hæmoptysis ceased in twenty-four hours.

The patient was admitted to an Australian lines of communication hospital on November 4. X-ray examination revealed a foreign body the size of a pea at the level of the neck of the ninth rib and a considerable right postero-lateral hæmothorax. On November 16 six ounces of blood were evacuated from the hæmothorax; it was not submitted for bacteriological examination.

On November 25 the patient was transferred to another Australian hospital. An X-ray photograph showed a large amount of fluid still present with considerable pleural reaction. The foreign body appeared to be in the medial wall of this encysted collection. On November 27 three ounces of blood-stained fluid were aspirated from the right pleural sac, but again not examined bacteriologically. On December 6 five ounces of blood-stained fluid were removed and this yielded a hæmolytic staphylococcus. The fluid was not obviously purulent and the patient was comparatively well, running an evening temperature of about 99·5° F. On December 9 five ounces of fluid, containing the same organism, were aspirated. On December 13 X-ray examination showed two distinct loculi in the right pleural cavity (see Figures IV and V). On December 14 five ounces and on

December 19 two ounces of fluid were evacuated (again growing *Staphylococcus hæmolyticus*). The fluid was now macroscopically purulent, although the patient's general condition and temperature range had not changed.

On December 21, under "Pentothal Sodium" anæsthesia, an intercostal tube was inserted at the site of election. Drainage through this tube was inadequate owing to congenitally very narrow rib interspaces (the patient was a very small man), and on January 6, 1943, under local anæsthesia, three inches of the eighth rib postero-laterally were resected and the empyema cavity was opened. A definite septum was ablated and much old clot removed. The foreign body was not palpable. The underlying lung moved fairly well. Continuous negative pressure drainage was established, a Tudor Edwards tube being used.

On January 12, in order to facilitate transport to Australia, this tube was replaced by a slightly smaller one designed to drain into a dressing, and on January 16 he was transferred to a hospital ship.

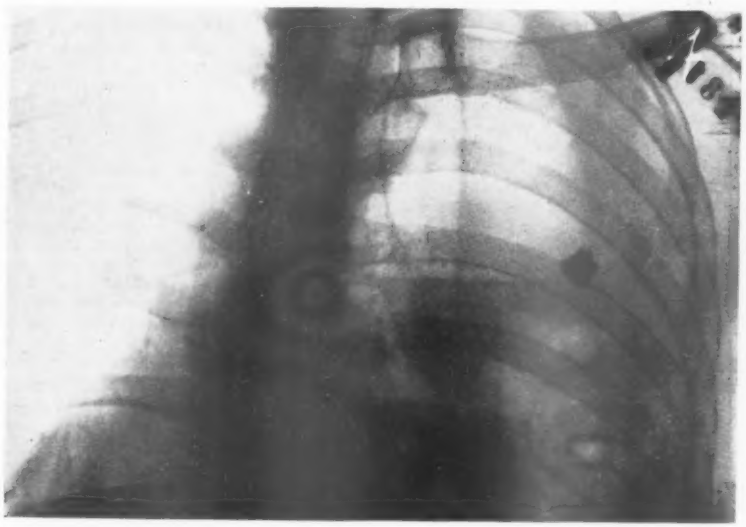

FIGURE VI.

Comment.—In this case also I consider the failure to empty the hæmothorax in the earlier stages was responsible for the occurrence of infection. There was further delay in providing adequate tube drainage. As in Case II, the temperature chart and general condition of the patient gave little or no indication of the time at which infection developed. Owing to the situation of the empyema cavity and the degree of respiratory movement of the underlying lung, complete recovery is probable.

Discussion.

Pathogenesis.

It is a common observation that clot formation in a hæmothorax is minimal until its contents become infected. Infection seems to be the signal for the deposition of large masses of blood clot on the walls of the cavity and throughout the mass of liquid. Some of these latter clots may become grouped into septa and this is especially liable to happen if the underlying lung has begun to expand unevenly—a not unlikely occurrence in penetrating injuries. These septa may be complete—that is, completely shut off one part of the empyema cavity from another—or incomplete.

Morbid Anatomy.

The empyema cavity is divided into two or more completely isolated loculi by septa stretching from one pleural surface to another. In the early stages of their formation these septa are of fragile recent blood clot, but organization proceeds rapidly from the

pleural attachments and the septa become more stable. The peripheral blood clot at the same time begins to organize and thus both parietal and visceral pleura to "thicken", being covered with a layer of pale, partly organized clot. The lung beneath becomes bound down and its covering of "thickened pleura" stretches with difficulty when it has the opportunity to expand and obliterate the empyema cavity. The fluid in each loculus is, of course, infected with the same organism. Incomplete septa may be present.

Finally all the changes of chronic empyema may occur, including scoliosis, narrowing of intercostal spaces, crowding of ribs *et cetera*.

Treatment.

I do not propose to discuss the treatment in forward areas of penetrating chest injuries. The cases described in this paper are of the common type in which no intrapleural operation is required in the forward area, but the patient is evacuated to a casualty clearing station and hospital with a dressed wound (or wounds) and a hæmothorax. The treatment of such a patient may have to be taken over at any one of three stages.

Stage I.—This is the stage of the non-infected hæmothorax, and the treatment is the all-important prophylaxis of empyema.

By the time the patient arrives at a general hospital three or four days have usually elapsed. The wound, if small, may be covered by a scab and, if so, this will not be disturbed. Otherwise it will be treated on its own merits, which generally means the application of antiseptic dressings perhaps followed by secondary suture. "Sucking", of course, will be controlled.

In the treatment of the hæmothorax *per se* one has two objects—the evacuation of the contents and the reexpansion of the lung. Fortunately these run hand in hand. In connexion with the evacuation of the contents one has to consider when and how to do this. With regard to the former, one must wait until the bleeding has ceased and until the removal of the blood will not cause its recurrence. Speaking generally, this means four days of waiting. Aspiration can then be performed with impunity (a watch on the hæmoptysis, if any, is useful as a guide). It is of the utmost importance that evacuation of the pleural cavity should be effected at an early date and not deferred *sine die*, as happened in the three cases recorded here. Early and complete removal of fluid is the most important means at our disposal in the prevention of empyema.

Small collections—up to about thirty ounces—can be satisfactorily emptied by aspiration with a wide-bore needle. Larger collections cannot be readily evacuated at one sitting by this means. Easily the best way to deal with these larger collections is by inserting an intercostal tube about the calibre of the average lead pencil. A controlled emptying is obtained by drainage into a bottle under antiseptic fluid. Should the patient show signs of distress, the tube is immediately clamped for an hour and then the clamp removed. Air replacement is sometimes used as an adjuvant to aspiration. I have not needed to use it and can see only one indication for its adoption—some special reason for resting the lung such as a very large intrapulmonary foreign body which it has been decided not to remove for the time being. All results should be checked by X-ray examination. Lung expansion is aided by breathing exercises which all chest cases must have. Administration of iron is routine and blood transfusion used where indicated.

Every specimen of fluid aspirated from a hæmothorax should be submitted to bacteriological examination by culture methods. Infection must be discovered at the earliest opportunity.

Stage II.—This is the stage of the infected hæmothorax. It is most important to emphasize that, in the early days of infection, the blood does not look purulent, that the temperature may be not unduly raised (Cases II and III), and that the patient may neither feel nor look ill. As soon as a positive culture is obtained a further specimen is secured for confirmation, immediately upon which tube drainage must be instituted. I have not seen an infected hæmothorax successfully treated by simple aspiration. An intercostal tube of suitable size and thickness should be inserted low down in the hæmothorax and continuous negative pressure employed. The failure of adequate drainage along such a tube in Cases II and III is unusual and was due to the very abnormally narrow intercostal spaces. Should intercostal tube prove inadequate, rib resection will be performed, clot evacuated and drainage established. Sulphonamides will, of course, be used as indicated.

Stage III.—This is the stage of loculation. Full drainage must be effected without delay. If the septa within the empyema cavity are still flimsy an intercostal tube with negative pressure may break them down (as in Case I). Whether this has occurred can be ascertained by radiography and if, at the end of a week (earlier if general condition indicates), undrained loculi are still present, rib resection should be performed, the septa broken down and all clot removed. This procedure is readily carried out under

local anæsthesia. It needs careful planning of the incision with reference to X-ray appearances and aspiration findings. The later treatment in these cases is along the routine lines adopted for empyema.

General.

The presence of retained intrapulmonary foreign bodies does not invalidate these remarks. Either it is decided to remove foreign bodies early or the hæmothorax is cleared up first and the decision to remove or leave them is then made.

Summary.

1. Three cases of loculated empyema following hæmothorax are reported.

2. In the treatment outlined for the condition emphasis is laid on the following points: (*a*) early and complete emptying of a hæmothorax; (*b*) early tube drainage of an infected hæmothorax; (*c*) early tube drainage with breakdown of loculi in the case of loculated empyema.

Acknowledgement.

I should like to express my thanks to the Director-General of Medical Services for his permission to publish this article.

CYST OF AN EPIPLOICAL APPENDAGE OF THE PELVIC COLON.[1]

By Thomas F. Rose,
Major, Australian Army Medical Corps.

It is well recognized that the epiploical appendages of the large bowel may be affected by various pathological conditions such as torsion[1][2] and calcification.[3] They may even cause an intussusception of large bowel[4] or intestinal obstruction.[5] There is nothing in the available literature, however, concerning cysts of the epiploical appendages. Consequently this condition must be very rare, and a case report of a patient who had a cyst of an epiploical appendage of the pelvic colon is presented.

Clinical History.

The patient was a married woman, aged thirty-two years. At the age of fourteen years she had an appendiceal abscess drained by a rubber tube through a McBurney incision. The appendix was not removed until six months later, when appendicectomy was performed through a paramedian incision.

The patient then enjoyed normal health, but a small incisional hernia gradually developed through the original McBurney incision. It was easily reducible and caused no pain. As it did not increase in size, medical attention was not sought.

Ten days prior to her present illness, while she was moving a heavy piece of furniture, the hernia suddenly became painful and increased rapidly in size. It was hard and tender and could not be reduced. The pain was localized to the site of the swelling and did not radiate. It made her vomit at its commencement, but apart from this she had no abnormal alimentary symptoms. The swelling remained constant in size, but the pain and tenderness became gradually worse during the next ten days. There were no symptoms referable to other systems. The menstrual history was quite normal.

Examination, on the tenth day of her illness, revealed an apparently healthy young woman. Her tongue was clean and she had a normal temperature and pulse rate. She walked in a slightly flexed position to ease the pain in her right side.

Abdominal examination showed the scar of the right paramedian incision and a large swelling in the right iliac fossa. The attenuated scar of the McBurney incision was stretched over the summit of the swelling. This mass was tender, rounded and smooth and appeared to be firmly attached to muscle but not to skin, which could be moved freely over it. It was not reducible into the abdomen, gentle pressure only being used. All other systems appeared to be normal. A diagnosis of an incarcerated omentocœle through a hernia of a McBurney incision was made.

Operation performed next day revealed a large hernial sac protruding through the musculature of the right iliac fossa with a neck admitting three fingers. The wall of the sac was composed of thinned out peritoneum and skin, which mostly consisted of the stretched out scar of the previous incision.

Instead of omentum, the sac contained a spherical, lobulated, smooth walled cystic mass three inches in diameter. It was attached to the hernial sac by a few fine recent adhesions which were easily divided. This cyst was attached to the antemesenteric border of a loop of pelvic colon by a short pedicle, half an inch long and an inch broad, containing fat and blood vessels only. It completely occupied the hernial sac, whilst the pedicle occupied the neck of the sac. The bowel itself did not enter the hernia. Some free fluid was present in the sac. The cyst was then removed by careful dissection through the pedicle, care being taken that there was no diverticulum of bowel in it.

The abdomen was then explored and the pelvic organs were found to be normal. The caecum was behind the apex of the loop of pelvic colon and was surrounded by adhesions. No signs of any further cysts were found in the abdominal cavity as far as could be ascertained through the incision. The large bowel was normal and no signs of diverticulosis were present.

The hernia was then repaired in the usual manner. The patient had a normal convalescence. When seen five months later she was very well.

Description of the Cyst.

The cystic mass was lax, smooth and spherical. It was easily mobilized from the hernial sac by the breaking down of fine recent adhesions. It was lobulated and was

[1] Accepted for publication on September 12, 1944.

reddish in colour with some thin flattened areas of fat beneath the serosal surface. It was attached to the antemesocolic border of a long looped pelvic colon by a pedicle, half an inch long and an inch broad, containing blood vessels and fat. There were no signs of a diverticular process from the lumen of the large bowel to the cyst; there was no evidence of torsion of the pedicle.

On macroscopic section the cyst was found to be multiloculated, consisting of five perfectly rounded smooth wall cysts, whose lumina had no connexion with one another. Each was filled with clear straw coloured fluid with no sparkle of cholesterin crystals. The thin lining membrane of each was white and perfectly smooth, and it rested directly on a thin fibrous looking layer. The cysts were bound together by delicate connective tissue to make the lobulated cystic mass, the whole of which was covered by a thin peritoneal layer. There was no evidence of hair or sebaceous material as in a dermoid cyst. There were no mural plaques and no evidence of the tumour being a collection of hydatid cysts. In fact, the cyst looked like a small multiloculated cystadenoma of the ovary. It was unfortunate that facilities for microscopic examination were unavailable.

Owing to its position, the appearance of the pedicle and the plaques of subserosal fat, it was decided that anatomically this cystic mass was in an epiploical appendage of the pelvic colon. Its position in the hernial sac was due to the sudden straining of the patient.

Comment.

The ætiology of the cyst and how it came to grow in an epiploical appendage are quite undetermined. Subserosal enterogenous cysts, though rare, are well known to occur in relation to the small intestine, especially in the ileo-caecal region.[6] Such cysts are unilocular and they arise as a diverticulum from the bowel lumen. They later lose their attachment to bowel, but their walls always reproduce the structure of the gut. They are not described, however, in relation to the large intestine, in which congenital diverticula, especially of the pelvic colon, occur with extreme rarity.[7]

If this cyst was unilocular, it might possibly be considered as enterogenous in origin, the intracystic pressure causing the walls to become thinned out and flattened and so to lose the appearance characteristic of bowel mucosa and wall. However, it was multiloculated, and though its walls were very thin, the intracystic pressure was low. There was no evidence of diverticulosis of the pelvic colon, consequently this condition could not be considered as a possible explanation of the ætiology.

Both ovaries were present in the normal position, and though the cyst had the appearance almost of an ovarian cystadenoma, nevertheless, accessory ovarian tissue, when present, is found in the broad ligament. Accessory endometrial tissue may be found in the pelvic colon and may even cause tumour formation, but the macroscopic appearance of such tumours is characteristic and nothing like that displayed by the tumour under consideration.

Summary.

The history of a patient with a multiloculated cyst in an epiploical appendage of the pelvic colon is presented. Its macroscopic pathology is described.

The ætiology of the condition is quite unknown and the case is presented for its interest and its rarity.

Acknowledgements.

I wish to thank the Director-General of Medical Services, Major-General S. R. Burston, for permission to publish this case.

My thanks are also due to Dr. Pat Richardson, of Perth, who referred this patient to me, and to Miss N. Andrew, librarian to the Royal Australasian College of Surgeons, for her help in searching the literature to find a similar case.

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[7] A. L. McGregor: "A Synopsis of Surgical Anatomy", Fourth Edition, page 388.

Surgery in Other Countries.

[In this column will be published short résumés of articles likely to be of practical value from Journals published in other countries and not readily accessible to surgeons in Australia and New Zealand.]

ENCEPHALOPATHIA THYREOTOXICA.

Paul Rudstrom (Upsala): *"Über Encephalopathia thyreotoxica: Eine Übersicht aus Anlass eines operierten Falles", Der Chirurg*, May, 1943, page 296.

In 1911 Kappis collected from the literature a large number of cases of Graves's disease with evidence of central nervous system derangements. In the main, these consisted of ocular pareses, together with a more fatal type showing indications of bulbar palsies. He reported with them a case of his own in which after thyreoidectomy the paralytic condition swiftly subsided. Klein in 1928 also reported a case in which the patient had a central nuclear affection, of bulbar type, the symptoms of which arose acutely with the onset of Graves's disease and subsided rapidly after thyreoidectomy. Both of these authors attributed the nervous phenomena to a thyreoid intoxication, and gave to them generally the name of *"encephalopathia thyreotoxica"*.

Zondek also published a series of thirteen cases under the name *"coma Basedowicum"*, the patients showing the same general appearances. Nine of these patients died within two to eight days of the onset of the acute symptoms, and in those cases in which unconsciousness supervened, the prognosis appeared to be hopeless. Only one patient of this series was operated upon, and in this case improvement resulted. The goitres were mostly small, but the toxic symptoms were very marked. The microscopic appearances of the thyreoids varied between those of typical Graves's disease and those of a colloid goitre. No gross or microscopic changes were found in the brain of any of the patients. Several other workers have written on this subject. Of these, Risak refers to a cerebral type of hyperthyreoidism peculiar to older people. Since the thyreogenic hormene of the pituitary was discovered and its intimate functional relation with the basal nuclei was better understood, greater attention has been paid to this factor. Josefson reported a case in which the encephalitic symptoms preceded the onset of typical Graves's disease, and another in which thyreotoxic symptoms followed an aneurysm of the internal carotid artery. In both of these cases the thyreoid gland was easily palpable. Modern states that the combination of cerebral and thyreotoxic symptoms is common in America, and Rudstrom agrees that the milder forms of it are not rare in Sweden. But severe degrees of cerebral involvement are very unusual there. He has been able to find reports of only eight cases from Scandinavian countries.

The prognosis is generally very bad in such cases, particularly if the cerebral symptoms are at all well marked; but surgical treatment is seldom undertaken, and Crile's report on the results of such treatment is not encouraging. In the present article Rudstrom reports a case in which the connexion between the thyreotoxicosis and the lesions of the basal ganglia was clearly established, and in which operative treatment brought swift cure.

The patient was a woman, fifty-two years old. In March, 1941, following a severe influenzal type of illness, she began to lose weight, in spite of a good appetite. By November there was a rapid deterioration of her condition, with restlessness, sleeplessness, tremor, muscle and joint pains, a dry throat and the loss of fifteen kilograms of weight. Her basal metabolic rate was + 62%, but there were no central nervous symptoms at this time. After three weeks of steady improvement under iodine therapy, there ensued a sudden increase of all thyreotoxic symptoms and at the same time a very well marked Parkinsonian facies. The patient had a peculiar vacant staring expressionless face. The mouth was held half open and dribbled food. She complained of great thirst and dryness of the mouth. She lay inert on her back and was unable to raise herself or even to feed herself. The restless movements of Graves's disease had disappeared. Her articulation was faulty and difficult to understand. Sensation was unaltered and all reflexes were normal. Pre-operative iodine treatment brought improvement in the pulse and temperature charts, but none in the cerebral symptoms. At the operation on February 4, 1942, sixty grammes of thyreoid tissue were removed, only very small remnants being left. Under microscopic examination this tissue was typical of Graves's disease, but there were irregular areas of parenchyma containing much colloid. In the immediate post-operative period the whole appearance of the patient underwent a striking change towards normal. On the sixth day she sat up and on the

eighth she was walking with a normal gait. This improvement has since been wholly maintained.

In this particular case at least it is clear that the thyreotoxic symptoms preceded those of cerebral origin; and the swift and excellent result of thyreoidectomy shows that the thyreoid toxins played an originating part in their causation. This point requires emphasis, since the apparently hopeless condition of this type of patient and the failure of iodine therapy may easily deter surgeons from undertaking the operation.

ARTHUR E. BROWN.

THE USE OF PLASTIC CORK IN THE MANUFACTURE OF ARTIFICIAL LIMBS AND ORTHOPÆDIC APPARATUS.

Rudolf Werner (Münster): "*Verwendung von plastischem Kork im Kunstgliederbau und bei orthopädischen Apparaten*", *Zeitschrift für Orthopädie*, Volume lxxiv, 1943, page 171.

THE purpose of Werner's article is to introduce a method whereby the difficulties associated with the shrinkage and alterations in shape of amputation stumps, which occasion great delay in the fitting of proper permanent artificial limbs or prostheses, can be obviated. Not only is there the need to wait months for the first permanent limb to be made, with its demoralizing period of peg-leg or crutches, but even when the prosthesis is fitted, weight-bearing immediately causes further alterations in contour of the stump. Attempts to avoid the difficulty by means of lace-up leather "funnel" sockets lined with felt have not proved satisfactory. The felt soon becomes soaked with sweat and causes irritation to the skin, and within a year a new socket for the limb is very often required.

Werner therefore draws attention to the advantages of "plastic cork" in the making, refitting and remodelling of artificial limbs and prosthetic apparatus. The substance can be purchased as a commercial product, but it can more cheaply and more conveniently be made by grating up ordinary cork into moderately coarse granules, and mixing these into a paste with celluloid-acetone. The consistency can be varied as desired. If the body surface is very irregular a fairly fluid paste is best; but if the surface has to take pressure, as for instance weight-bearing, a stiffer paste is more convenient. Werner finds that the commercially prepared plastic cork is ground too finely and is not so satisfactory, and is in addition more expensive.

In the use of this material the inner surface of the socket where the cork is to be used is smeared with celluloid-acetone; the cork paste is then spread on, rather more thickly than is felt to be absolutely needed. The stump is then wrapped in a paper bandage and carefully introduced into the socket of the apparatus, which is thereupon made to take normal weight-bearing. This ensures exact correspondence of the cork surface with the body surface. Finally the stump is carefully and slowly withdrawn, a perfect negative of its contours being left in the cork lining of the socket. This cast must be left for two to three days to dry in the air, according to its thickness, after which the remains of the paper bandage are removed and any roughnesses are smoothed off by the file. When it is again fitted to the patient, very few further adjustments are found to be necessary.

The result is very pleasing to the patient, who feels no sense of looseness nor of a "foreign body" in the socket. On the contrary, the close adaptation of the socket to the stump brings about a feeling of organic completeness. Sometimes, before one has gained the necessary experience, or later in difficult cases, a certain amount of packing up of the socket is necessary. In the case of thigh stumps this may be managed by disconnecting the limb at the knee, and under vision packing in the cork paste through the open lower end of the socket, or perhaps more easily by cutting apertures in the socket and packing through them.

The advantages of this substance are, in addition to its cheapness, the fact that it is easy to work and moulds easily to the form. Its lasting qualities are great. Rises of temperature and soaking with sweat do not affect it. It forms a solid inner lining equally for wooden or leather sockets, and it is everywhere easily accessible.

ARTHUR E. BROWN.

PRACTICAL POINTS IN THE DIAGNOSIS AND TREATMENT OF PROSTATITIS.

Rudolf Wawersig: "*Praktische Winke zur Erkennung und Behandlung der Prostatitis*", *Medizinische Klinik*, Volume xxxix, 1943.

IN spite of the sulphonamide treatment of gonorrhœa, prostatitis, both acute and chronic, is still common; and the diagnosis and treatment of this condition in its chronic form especially still present difficulties.

With any long-standing case of gonorrhœa, when the two-glass test shows that the posterior part of the urethra is involved, it must be assumed that gonococci have invaded the prostatic ducts and produced a "catarrhal" prostatitis. In such a case gonococci should be recoverable from the prostatic secretion.

From this stage, the next, "follicular" prostatitis, develops, with the formation of small abscesses which burst into the urethra and heal, but leave behind scar tissue and thereby, through stenosis of the ejaculatory ducts, lead to sterility. The main symptoms of follicular prostatitis are strangury, scalding micturition and terminal hæmaturia.

Further extension of the infection produces a parenchymatous prostatitis in which stage the gland is greatly swollen and very tender. A large prostatic abscess may result and may burst either into the urethra or the rectum or both, with the formation of a urethro-rectal fistula. This form is characterized clinically by high fever, rigors, severe perineal pain, often constipation and sometimes retention of urine.

In the diagnosis of prostatitis, a "three-glass" urine test is used. The first glass contains any pus from the anterior part of the urethra. Pus in the second comes from the posterior part of the urethra or bladder. Before the third glass is filled the prostate is massaged and pus in this specimen comes from the prostate itself. Microscopic examination of the unstained prostatic secretion will show leucocytes and red cells. A few of these may be present in normal prostatic fluid; but if they are plentiful, the diagnosis of prostatitis may be regarded as established. All forms of organisms are found: gonococci, streptococci, staphylococci, pneumococci or *Bacillus coli*. It is a matter of some practical importance to note which of the two, leucocytes or cocci, are present in the greater numbers. In "non-specific" urethritis the prostate may also be involved and should be examined in all cases.

In palpation of the prostate not much of an unusual nature is felt in catarrhal cases; but small tender nodes can be felt in the follicular type close to the medial line on one or other side. The parenchymatous form is obvious.

The symptoms of a prostatitis which has become chronic are manifold and misleading. "Sciatica" or "lumbago" should always be suspect as primary diagnoses and the patient examined for possible prostatitis before being empirically treated. Pain in the testicles or cords or pain in the renal regions or loins may be due to chronic prostatitis, and the possibility should be carefully explored. Stubborn genital or anal eczema may have a similar origin. In fact any pain in the ano-genital area may conceivably be a manifestation of this condition; and so may sexual symptoms ranging from impotence to premature ejaculation.

The treatment of acute prostatitis is similar to that of acute posterior urethritis. Strict confinement to bed is necessary until the urine can be passed easily and quietly again. Heat is to be applied in any convenient way. The thermophore is the best, but failing that, hot packs to the perineum or hot sitzbaths, navel deep, should be used. Local measures such as urethral irrigation or prostatic massage are ordered as considered necessary. Suppositories containing ichthyol and belladonna help to ease the urinary straining. And sulphanilamide or other forms of sulphonamides are used in doses of approximately five grammes daily for two to five days. This treatment is said to cause the gonococci to vanish swiftly and to bring prompt subsidence of the symptoms.

For chronic prostatitis, Wawersig is less optimistic. He holds that prostatic massage is the most useful treatment, and that the gland should be massaged with considerable firmness for approximately one minute on two occasions a week and continued for five or six weeks.

ARTHUR E. BROWN.

SPINAL ANÆSTHESIA IN FORWARD WAR AREAS.

Karl Wirth: *"Lumbalanästhesia im Felde", Zentralblatt für Chirurgie*, April, 1943.

ALTHOUGH with the development of stable and good solutions, such as "Percaine" and "Pantocaine", spinal anæsthesia had become widely used in surgery before the present war, it has been almost as completely neglected in the surgery of this war as it was in that of the last. This is the more surprising in view of the previously expressed opinion that further improvement in the results of treatment of penetrating wounds of the abdomen would largely depend on the wider use of spinal anæsthesia, and that such improvement in the results of abdominal surgery, especially in the forward areas, would be widely welcomed.

For the effective use of spinal anæsthesia in field hospitals and main dressing stations, two necessities are a simple technique and a completely reliable solution. The set packed in the German field kit includes a special two-way tap piece, but this is not essential. Two solutions are used, produced from the "Pantocaine" ampoules put up. Of these the best is the "dry" ampoule, which contains 10 milligrammes of the dry

flocculent powdered "Pantocaine". The other ampoule contains 2·0 cubic centimetres of a "Pantocaine-racedrin" solution, in which 0·133 gramme of ephedrin is dissolved in 1% "Pantocaine" solution. This latter is mainly used for anæsthetizing the needle track for the puncture. The dry "Pantocaine" is dissolved in the soldier's own cerebro-spinal fluid, and it does not deteriorate with keeping, is not contaminated by moulds or pyrogens, and it always produces a solution of constant strength. It is therefore particularly suited to forward area conditions.

Spinal anæsthesia is mainly useful for wounds of the lower abdominal area, pelvis and perineum. Its special advantages are not so evident in work on the lower limbs. Also it is not necessary to limit its use to lower abdominal work. By making the injection higher in the vertebral canal a higher upper level can be achieved. An injection given between the tenth and eleventh dorsal spines will give anæsthesia over the whole surface of the abdomen. For a level to cover work on the middle or lower part of the abdomen, an injection one or two spines lower respectively is adequate. The ordinary injection, thus given, will produce anæsthesia as high as the sixth dorsal vertebra, which is also sufficient to enable a surgeon to carry out those short procedures which are often found necessary in the upper abdominal area.

The injection is given with the patient on his side, knees to chin. Two cubic centimetres of cerebro-spinal fluid are drawn off into a dry "Pantocaine" ampoule and the powder is dissolved in the fluid. A further 2·0 cubic centimetres are drawn off and put into a second ampoule for use if needed. Each ampoule now contains 2·0 cubic centimetres of a 10% solution of "Pantocaine", of practically the same specific gravity as the cerebro-spinal fluid itself. One cubic centimetre of this solution is injected fairly quickly into the theca, and it is followed in five minutes by a further 0·5 cubic centimetre and after a minute by another 0·5 cubic centimetre. Between these injections the development of anæsthesia is watched. A feeling of warmth, disappearance of pain, priapism, loss of the abdominal reflexes and bulging of the abdominal wall on coughing are all signs of the onset of satisfactory anæsthesia. Should the anæsthetic level not extend high enough, a further 0·5 cubic centimetre is injected, and this is repeated until the desired level is reached. It is unusual for the whole 20 milligrammes of "Pantocaine" to be needed, and more than this amount should never be used. With careful testing, a segmental type of anæsthesia can be demonstrated, the lower lumbar and sacral segments being excluded. For the upper part of the abdomen the anæsthesia should reach to the fourth and fifth dorsal segment; for the lower, to the sixth and seventh.

Before the puncture, all patients receive "Dilaudid" or morphine with atropine. During the operation in cases of abdominal wounds, and in the case of all dehydrated patients, saline solution is given by the subcutaneous or intravenous route, and pulse, respiration and blood pressure control is continuous. In after-care there are no special requirements due to the method, beyond the need to keep the patients flat for twenty-four hours. In those few cases in which severe headache is present, it can be easily relieved by the use of subcutaneous saline infusion.

This method of anæsthesia has its own particular advantages. Only a small number of cases make up Wirth's series, 34 in fact, and this is, he admits, far too small for a comparative assessment, especially where the facts involved in the circumstances of wounding, conditions of transport and so on vary so widely. But it has been found to be no more time-consuming than the inhalation methods, and has not been found to hold up the work of a field hospital. Casualties so operated upon should not be evacuated within twenty-four hours of the operation, but otherwise the objections commonly raised against the use of spinal anæsthesia have not been found to have any foundation. On the other hand, the method has positive and definite advantages. The relaxation of the abdominal wall and also of the bowel itself permits of a quiet and swift exploration of the whole abdominal cavity in a way which no other method offers. The surgeon is, too, more independent of the varying quality of skill in the anæsthetists available in a forward unit. Nursing personnel are not required to spend so much time watching the patient after the operation. There is no inflammable gas to cause worry with the open lights often needed. There is a more comfortable return to normal for the patient, and the toxic effects of a long-continued inhalation medium are absent. In fact, Wirth claims that this method is in many ways peculiarly suited to the conditions found in war surgery in forward units.

ARTHUR E. BROWN.

THE NEUROSURGICAL TREATMENT OF MEGACOLON.

Rapant: *"Unsere Erfahrungen mit der neurochirurgischer Behandlung des Megakolons"*, *Zentralblatt für Chirurgie*, 1942.

RAPANT distinguishes between "idiopathic" and "symptomatic" megacolon, the criterion for the former being the presence of symptoms from birth. He reports five patients treated at Brünn, of whom four, including one adult, had megacolon of idiopathic

origin; the fifth, also an adult, was a woman whose symptoms followed a difficult labour and subsequent sterilization. Two of the patients with the idiopathic lesion, including the adult, were so greatly relieved by lumbar chain and superior hypogastric plexus resection as to be classed as cured. The relief in these two cases lasted for three and one and a half years respectively.

Surgeons have seldom to work among so many unknown factors as they do with megacolon. In this "surgery of function" the surgeon must scrupulously respect the topographical and anatomical relations of the changes found, and these changes cannot be accurately estimated beforehand. This is particularly true in regard to what is primary and what secondary; while, too, accurate apportionment of function to the various fibres of sympathetic and parasympathetic origin is still difficult.

Starting from the standpoint that the disease is due to an upset of balance between the sympathetic and parasympathetic nerve actions, one must assume that an operation which restores this balance, whether by accentuating the action of the one or diminishing that of the other, will be effective. But the question of vitality, tone and mobility of the muscular structures involved must be taken into account. To test these functions, as well as the general sympathetic tonus, spinal anæsthesia has been recommended. Rapant is not impressed with the method, since, used in the ordinary manner, it blocks both the sympathetic action and its antagonist. If Kirschner's zonal method is used, this objection does not hold so strongly, but this method is not applicable to young children. A much more effective test is the administration of 0·075 gramme of acetylcholin, as has been advocated by Takats. If this test shows the dilated bowel wall to be capable of contraction, the outlook for a good result from neurosurgical attack is favourable.

The general tendency nowadays is to make the surgical attack more radical rather than less. Pässler divides his cases roughly into three groups: (i) Those in which the anatomical changes are limited to the right side, including the hepatic flexure. The innervation concerned is from the cœliac plexus, the superior mesenteric nerves and the thoracic splanchnics. (ii) Those in which the left colon, including the pelvic loop, is mainly affected. This portion is supplied from the inferior mesenteric efferent fibres and to a lesser degree from the so-called superior hypogastric plexus. (iii) Those in which the pelvic colon, the rectal ampulla and the bladder are involved, the innervation being mainly from the superior hypogastric plexus.

Truly radical attack on the first group is physiologically not feasible. A less radical method and less dangerous is the bilateral subdiaphragmatic resection of the lumbar splanchnics. Should the inferior mesenteric area seem to be involved at all, the operation may be supplemented by bilateral resection of the upper lumbar ganglia, with possibly partial resection of the cœliac plexus.

Surgical approach to the second group is complicated by the intimate relation of the sympathetic paths with the parasympathetic fibres of the vagus and pelvic nerves. There is involved in any radical procedure the danger of producing sterility or impotence in males, which may result from extirpation of the superior hypogastric plexus. Resection of the inferior mesenteric plexus *plus* resection of the splanchnics and bilateral lumbar sympathectomy will in large measure damp down the sympathetic overactivity of the superior hypogastric plexus. In cases in this group in which the atony extends up to the splenic flexure, Adson's operation of bilateral lumbar sympathectomy should be supplemented by resection of the inferior mesenteric plexus, or, as advocated by Leriche, by bilateral resection of the thoracic splanchnics. Lumbar chain excision alone will be effective only in cases very little advanced. Unilateral lumbar sympathectomy is not, however, as useless as it is often said to be, for it may be used for very young children if the atony is limited to the sigmoid loop. Its effects, however encouraging at first, are usually transitory; but it may be used to tide over a critical time in an infant's life, and to offer by its results a guide to the efficacy of more radical treatment later.

For the third group, the countering of the sympathetic overactivity involved necessitates resection of the superior hypogastric plexus, of the lower lumbar splanchnics and of the lumbar chain on both sides. If this is done, a satisfactory result can be expected provided the bowel wall is still sufficiently active. It is necessary, however, to face the danger of damage to the pelvic nerves with consequent impotence.

In regard to post-operative treatment, a divulsion of the anal sphincter muscle should always be performed immediately after the operation, and the patient must make regular use of aperients and enemata for a considerable time.

Poor results may be due after these operations to incompleteness of the sympathectomy, which in children is very likely to be the cause, where the structures involved are so small. Technical difficulties also sometimes prevent a thorough removal of all fibres. But many patients can be relieved by this less dangerous

operation of sympathectomy, while others can be given no hope of relief by any method other than the more radical procedure of excision of the dilated thickened bowel. Both the neurosurgical and the radical methods have their place in the attack on the condition; and the results attained will demonstrate whether the indications for either method have been correctly estimated.

ARTHUR E. BROWN.

Reviews.

Fractures and Joint Injuries, Volume II. By R. WATSON-JONES, B.Sc., M.Ch.(Orth.), F.R.C.S.; Third Edition; 1943. Edinburgh: E. and S. Livingstone. 9¾″ × 6¼″; pp. 967, with 1,353 figures. Price: 75s. net, per set of two volumes.

VOLUME II of this work is divided into three parts, dealing respectively with injuries of the upper limb, injuries of the lower limb, and rehabilitation and organization. The volume is incomparably good and establishes the whole work as a classic. It is excellently published and very fully illustrated with line drawings, colour plates, and X-ray reproductions. The author's style is always easy and at once grips the reader's attention.

The principles of fracture treatment are simply enunciated and insisted upon, and the difficulties of complicated types are dealt with exhaustively. In the section on elbow joint injuries the author stresses the grave dangers of forced movements. It is a little disappointing to find that he avoids any dogmatic teaching regarding fractures of the head of the radius. Where there is so much to be said on both sides, it would have been welcome to have an authoritative opinion on the absolute indications for excision of the radial head. It is to be noted that in supracondylar fractures he prefers late corrective osteotomy to open reduction. He does not practise open operation for "T" and "Y" types of supracondylar fractures. The formidable fracture-dislocation which he calls the "baby car" fracture-dislocation, makes its first official appearance in surgical literature. There is a full account of the Monteggia fracture-dislocation. A long chapter deals very fully with injuries of the wrist and hand. Any surgeon dealing with casualties should carefully read this chapter, from which there can be few omissions. The chapter on lower extremities lays stress on the particular problems of the hip and knee joints and is very full and complete. The influence of war surgery is given its full value. The book ends with a chapter emphasizing the great importance of rehabilitation methods and of treating the patient's mind as well as his body. The author discusses the organization of a treatment centre and ends with a chapter of good reading on unusual cases.

The whole work is a great contribution to the thought and teaching of traumatic surgery. Moreover, it directs attention very directly to the continuing eminence of this great British school of traumatic and orthopædic surgery. It will act as a salutary antidote to a prevailing tendency to regard some Continental teaching with its somewhat mechanical outlook and complicated methods as the present gospel of traumatic surgery.

Handbook of Diagnosis and Treatment of Venereal Diseases. By A. E. W. MCLACHLAN, M.B., Ch.B., D.P.H., F.R.C.S.; 1944. Edinburgh: E. and S. Livingstone. 7¼″ × 4¾″, pp. 372, with 159 illustrations (19 in colour). Price: 15s. net.

"THE HANDBOOK OF DIAGNOSIS AND TREATMENT OF VENEREAL DISEASES", by A. E. W. McLachlan, was published just too early to include information concerning the use of penicillin in the treatment of gonorrhœa. This is regrettable, for penicillin has been widely accepted as almost specific in the treatment of Neisserian infection, and information regarding its use is looked for in new publications. The quality of this handbook is such that the publishers might consider the issue of pages dealing with penicillin for insertion in this edition.

McLachlan states in his preface that the volume "has been evolved as the result of the systemic and clinical instruction of undergraduate and post-graduate students over a number of years to provide a concise introduction to the principles of diagnosis and treatment of the venereal diseases". A handbook based on such experience should contain that essence of the principles of venereal disease control especially desired by the busy practitioner, and in this the author has succeeded.

Most attention is given to syphilis and here the information is well arranged. Acquired syphilis, its course and diagnosis, and the diagnosis of early generalized (secondary) syphilis are satisfactorily covered, as is the treatment of early infection.

Concurrent intermittent therapy, alternating continuous treatment and intensive short-term arsenical treatment by multiple injections of "Mapharsen" are considered in sufficient detail, with the exception of the last mentioned, in regard to which reference is somewhat brief for a method carrying risk of a high incidence of toxic sequelæ.

The section on intolerance and toxic reactions to arsphenamine treatment deals satisfactorily with complications likely to be encountered. Reference is also made to bismuth intolerance.

Late generalized (tertiary) syphilis receives satisfactory consideration, the important systems affected being dealt with separately. The chapter on neuro-syphilis gives clear directions for lumbar puncture and for the interpretation of the observations made on the cerebro-spinal fluid by the examining laboratory.

Congenital syphilis is well covered for a handbook of this size.

The minor venereal infections (for example, chancroid) receive sufficient consideration to assist in the making of a diagnosis and in the satisfactory giving of treatment.

The section allotted to gonococcal infection is detailed enough to ensure an appreciation of modern methods of diagnosis and treatment, with the exception of the use of penicillin. In treatment of gonorrhœa in the male the author appears to favour routine urethral irrigation in addition to sulphonamide therapy. Many medical practitioners do not consider this necessary or desirable.

The diagnosis and treatment of gonorrhœa in the female, though dealt with very briefly, should be illuminating to many medical practitioners who fail to appreciate the need for careful and repeated examinations when searching for the gonococcus, for adequate surveillance during treatment, and repeated tests over a period of several months after apparent cure.

The chapter on urethroscopy, though short, gives sufficient information to enable the reader to appreciate the use of a urethroscope. Harrison's urethroscope is favoured for examination of the anterior portion of the urethra and a special water-distension urethroscope, such as the Geiringer, for viewing structures in the membranous or prostatic urethra.

The volume is well printed and bound and the material pleasingly arranged. There are numerous tables summarizing information in a simple manner and many illustrations, some in colour, which are very helpful. As a handbook, adequate for the needs of the undergraduate and of the busy practitioner, this publication may be recommended.

Varicose Veins and Hæmorrhoids and Other Conditions: Their Treatment by Injection. By R. ROWDEN FOOTE, M.R.C.S., L.R.C.P., D.R.C.O.G.; 1944. London: H. K. Lewis and Company, Limited. 8½″ × 5½″, pp. 136, with 54 illustrations. Price: 12s. 6d. net.

IN this concise little book dedicated to Rodney Maingot, who writes a chapter on "The Operative Treatment of Varicose Veins", the author describes the procedures employed at the injection clinic of the Royal Waterloo Hospital. He considers that in modern times too many varicose veins are being treated by the operation of high ligation. He discusses tests for the competency of valves in the veins, indications for injection treatment and sclerosing solutions used. Of the injection treatment of hæmorrhoids he remarks that, provided the cases are properly selected and the right technique is employed, "nothing but good can come from this form of treatment"—a somewhat debatable statement. He condemns the injection treatment of hernia and varicocœle, but states that good results are obtained when it is employed to treat ganglia, bursæ and, to a less extent, hydrocœles, and he gives the technique of injection in detail for each type of case. This short book describes a corner in the structure of surgical procedures which often receives scant attention in larger surgical works.

Advances in Pediatrics, Volume I. Edited by ADOLPH G. DE SANCTIS; 1942. United States of America: Interscience Publications, Incorporated; Melbourne: W. Ramsay (Surgical) Proprietary Limited; Sydney: The Grahame Book Company; Angus and Robertson Limited. 9″ × 6″, pp. 315, with 45 illustrations. Price: $4.50.

THIS is an entirely new publication initiated with the object of providing an annual review of pædiatric advances. It is in no sense a textbook, nor a compilation of abstracts, but rather a collection of monographs by outstanding authorities.

An account of the recently recognized disease of human beings, toxoplasmosis, is from the pen of Albert B. Sabin, world-famed research worker. Although the protozoon parasite causing this disease in birds and animals has been known to science since 1909, Sabin and others have only recently discovered that certain forms of congenital

encephalitis and hydrocephalus in children are due to its activities. Experimental toxoplasmosis lends itself to chemotherapeutic control; therefore, it behoves clinicians to become familiar with its manifestations and pathologists to realize that neutralization and complement fixation tests in regard to it are possible. To date no case has been reported in this country.

In a review of virus diseases by Horace L. Hodes from the Johns Hopkins University School of Medicine it is gratifying to note references to the work of Dr. F. M. Burnet and associates of the Walter and Eliza Hall Institute of Research on anterior poliomyelitis. Interest has been revived in respect to the mode of entry of the virus of anterior poliomyelitis in man. The most recent trend of opinion favours the gastro-intestinal route following experimental work on chimpanzees. These animals are much more closely related to man than are the Rhesus and Cynomolgus monkeys hitherto used in research. Active immunization against the disease and prophylaxis by convalescent serum receive but little support. A forerunner of still more recent opinion on treatment indicates that mass movement away from splinting and rest would be most unwise until additional carefully supervised experience is gained.

Chemotherapy, especially with the sulphonamide drugs, is discussed over a wide range of diseases by B. J. Carey. Many of the problems unsolved at the time of publication, however, have since been solved and will, no doubt, be elaborated in future volumes. Penicillin is not mentioned, as the investigations of Fleming and Florey had not gone beyond the experimental stage when the book was published.

Robert Gross, of Boston, contributes an illustrated article on persistent *ductus arteriosus* and its surgical treatment. The prognosis for individuals with a patent ductus cannot be stated broadly or with certainty; hence in selected cases for operation a very careful study must be made of each individual subject. An overall surgical mortality of 5·5% occurred among 36 patients operated upon and ranging in age from eleven months to thirty years.

A chapter on electro-encephalography indicates the future value of this method of investigating brain problems. In many children cerebral tumours, epilepsy and functional seizures are capable of differentiation by a study of brain wave patterns.

H. G. Poncher discusses vitamin *K* and hæmorrhage in the newborn, and concludes that in prophylaxis and therapy it plays a limited but significant role. The recently discovered Rh factor receives no mention, possibly because its scientific accuracy had not been sufficiently established when Poncher wrote.

Other articles dealing with the premature infant, tuberculosis, endocrinology and some references to oxyuriasis and its treatment with gentian violet and the newly discovered cystic fibrosis of the pancreas complete the volume.

"Advances in Pediatrics" is a welcome addition to pædiatric literature, serving both the specialist and the general practitioner. It displays a breadth of view and high critical standard by writers having profound general experience in addition to their own particular speciality. Future issues will be awaited with considerable interest.

Proceedings of the Royal Australasian College of Surgeons.

COUNCIL MEETING.

Admission of New Fellows.

AT a meeting of the Council of the College held in Melbourne on Saturday, October 7, 1944, the following were admitted to Fellowship.

General Surgery.

New South Wales: Charles Houston Horsley, Alexander Skeffington Johnson, Patrick John Kenny, Charles Henry Wickham Lawes.

South Australia: John Russell Barbour.

Victoria: Russell Norfolk Howard, Douglas Robert Leslie, Alexander Dougald Matheson, Stanley Francis Reid, Frank Douglas Stephens.

New Zealand: Murray Alexander Falconer, Edward Gardner Gibbs.

Ophthalmology.

New South Wales: John William Lennox Price.

POST-GRADUATE EDUCATION IN SURGERY.

THE Council of the Royal Australasian College of Surgeons realizes that many medical officers now on service are anxious to learn what the College can do to help them in the field of post-graduate education in surgery when the war is over. It believes that the provision of suitable opportunities for this education is the most important function of the College and intends to do everything in its power to help Australian and New Zealand medical officers to obtain it. It seems desirable, therefore, to acquaint all those who are anxious to undertake advanced training in surgery with the main features of the Council's proposals. It must be understood that, at the present time, these can be published only in a broad and general manner. More precise details will be made known at a later date.

Financial Assistance.

The Council has husbanded the financial resources of the College during the war in order to provide funds to assist selected candidates for its Fellowship to undergo the necessary training. The income from that portion of the Gordon Craig Endowment set aside for this purpose has been allowed to accumulate and now amounts to a considerable sum. It is proposed to use this money in the first two or three years of peace, to help as many suitable candidates as possible. The Council reserves to itself the right to determine the allocation of this money, but, as has been stated, it is to be used to foster post-graduate surgical education in Australia and New Zealand.

Post-Graduate Teaching.

The Council desires to emphasize the fact that the College is not only an examining but is also a teaching body. In this work it will seek to cooperate with all other bodies concerned with post-graduate surgical teaching. It has established a post-graduate school at Prince Henry's Hospital, Melbourne, which will be open to men from any part of the Commonwealth and the Dominion, and, in addition, is negotiating with hospitals elsewhere with the object of establishing similar facilities in other places. Portion of its funds will be made available, if required, for this purpose. Its chief object is to create as many positions as possible for men who desire to undergo that period of "surgical apprenticeship" which is demanded of all candidates for its Fellowship. In this connexion it is proper to mention the fact that the Censor-in-Chief has been authorized to give credit for training of this type obtained in service hospitals.

Alteration in Examination Regulations.

It will no longer be necessary, after a date to be notified, for candidates for Fellowship to possess a senior surgical qualification. The College examination will be in two parts. The first part will consist of an examination similar to that of Part I of the examination for the Master of Surgery degrees in the Australian universities. Candidates who have passed a similar examination at an approved university or College of Surgeons may be exempted from Part I of the examination for Fellowship of the Royal Australasian College of Surgeons. The examination for Part II of the College Fellowship will be partly written and partly oral. It will include, in addition, clinical and operative tests. All candidates must pass an examination in the general principles of surgery, but may elect to be examined, apart from this, either in general surgery or in one of the following specialties: ophthalmology, laryngo-otology, orthopædics, gynæcology, urology.

Conclusion.

In conclusion, the Council desires to emphasize the fact that it is anxious to cooperate to the fullest degree possible with universities, hospitals and post-graduate committees in the important duty of providing facilities for post-graduate surgical training, including the preparation of candidates for its examination. It hopes that it will be possible to collaborate with universities and post-graduate committees in regard to preparation for Part I of its examination, but, naturally, it feels that it must exercise a large measure of control of the purely surgical training demanded of candidates who desire to proceed to Part II of the examination for its Fellowship.

ALAN NEWTON, President.
W. A. HAILES, Censor-in-Chief.